THE

ELECTRICAL REVIEW.

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"ELECTRICAL REVIEW."

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THE

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THE TRAMCAR BRAKE QUESTION.

THE recent deplorable accident at Chatham, following at so short an interval almost identical accidents at Devonport and Glasgow, although at Glasgow no car was actually overturned, will impress still more lastingly on the minds of the general public the notion that travelling by electric car is fraught with considerable danger.

We know, of course, that an actual investigation will prove the proportion of accidents, either fatal or serious, to the number of passengers, to be almost infinitesimal, and we are inclined to fall back on the well-known and unaccountable fact that accidents of a similar description generally occur in batches. But we have not done the whole of our duty as a responsible journal if we leave the matter at that, express the usual regrets, and trust that such disasters will not recur. It is our duty to ventilate thoroughly the whole question of the causes of these accidents, to ascertain, if possible, with whom the real responsibility lies, and to suggest remedies.

Of course, the primary cause of a car running away is the failure of the brakes to stop it.

Now, in our opinion, brakes fail to act from two causes only. One of these is a defect in the design or mechanism of the brake itself; the other cause is a defect in the operator of the brake—*i.e.*, the driver.

These causes are fair and large subjects for discussion, and we have opened our "Correspondence" columns to anyone who has a word to say on them. The response, so far as superficial area goes, has been satisfactory, but we regret that, with a few notable exceptions, much of the correspondence has displayed either ignorance, bias, or interestedness. Whether it is that the men who do know are unable or unwilling to give their knowledge for the public weal; or whether it is—and we cannot believe this—that there are very few men in England who do appreciate the nature of the problem; we certainly regret that this correspondence has not been of more practical value.

Let us consider first the question of the brake. Looking at it in a general way, there are only two types in use; one depending on the rotation of the wheels, the other on the pressure of the car on the rails. There are several varieties of each type which may be discussed later. For the present we shall be content to consider which of these types should be fitted to a car, or if it is necessary to fit both.

Perhaps it will be well to look at the issue through the eyes of a *good* driver. This man says:—"If I am driving a car on which the brakes are of the type which acts in one way or another through the rims of the wheels, I know that directly the wheels stop revolving while the momentum of the car is not overcome, the brakes are practically inoperative, at all events for the purpose of a rapid stop; but I know also that on any grade which does not exceed 1 in 12 to 1 in 14, there is no excuse for so handling the brakes and sand-gear as to skid the wheels. Even on the steepest grades

travelled by electric cars there is no possibility of this occurring if I have observed speed regulations and know my business. Nevertheless, on a route where there are long or very steep grades, I always feel safer and keep fresher if the cars are provided with some form of track brake. If this is of the quick-acting variety, it is useful as an emergency brake, but I can handle the emergency brakes acting through the wheels with equal effect."

Luckily this type of man is not the freak some people would have us suppose, and in every system where the men are carefully selected and carefully trained such men are in the majority. These are the men of whom it has been said that the management only hears of them on pay day, for they never have accidents. And this happy state of things is not brought about by the masterly handling of any kind of emergency brake, for these men *do not run any risks*, and use the emergency brake only to save the life of some careless foot passenger. Our correspondent "Driver" appears to be one of the men who are always using the "emergency" to avoid accidents, probably because they run at speed right up to the obstacle before putting on the brake, and so take risks which a good driver would avoid.

Nevertheless, the best organised system must contain a proportion of men who never will be in the first rank, and the public have to be guarded against the indiscretions of these men. On that account some form of track brake should be fitted to all cars operating on grades of real severity, on which there is any chance of a car running away by reason of the mishandling of the wheel brakes. We believe that track brakes are entirely unnecessary except under these conditions, and we hold the opinion that it would be a very wasteful process to equip cars with a quick-acting track brake for emergency work only. As a matter of fact, a quick-acting brake of any kind, which requires the smallest amount of muscular energy to operate, is too often an incentive to fast and careless running, and is indirectly responsible for many accidents, because the men who take advantage of it are just those who have not the sense or the presence of mind to use it properly when the critical moment arrives.

It is for these men that inventors try to design brakes which will pull up a car in a minimum of time, whereas it is really the men who ought to be pulled up—by the neck, for they are all potential murderers.

Perhaps not all; some are merely intermittent lunatics of a very dangerous type, for they "lose their heads" just at the moment when their previous experience and training should make them able to cope with any emergency.

No men could be better trained, in theory, than the Glasgow drivers, yet the recent accident was caused by one of them failing to turn a handle in the right direction; in fact, he had two perfectly simple methods of stopping the car running backwards, neither of which required any muscular effort, and he failed to use either. No brake on earth, however instantaneous and certain in action, will prevent this particular kind of accident.

Our views on this question of brakes were expressed in a leading article of December 13th, 1901, and, with slight modifications suggested by wider experience, those views are still sound; but we hold most emphatically that the real question is not so much one of the choice of brakes, which may be left fairly safely to the responsible engineers, but one of the men who handle those brakes. Every one of the recent gruesome accidents was caused, beyond a shadow of doubt, not by any inherent defect of the brake system, but by the incompetence—perhaps only temporary, but just as fatal, for all that—of the driver. If there is even a moderate percentage of this type of man driving cars to-day in England, only awaiting the psychological moment to create disasters, we think that everyone will agree that the position is a very serious and alarming one. We regret to say, from what we can see and hear on all sides, that we are only too well justified in the belief that the percentage of drivers who are either incorrigibly reckless, unfortunately ignorant, or sufficiently unbalanced mentally to do the wrong thing in a crisis, is far from being moderate.

The incorrigibly reckless can be weeded out well enough, and quickly enough, by any manager who is up to his work, and experience teaches us that the sack, without mercy, is the only remedy for this class of man. They are untamable and untrainable.

The "unfortunately ignorant" class is that with which much can be done by proper treatment, but the very fact that any of this class, or of the preceding class, are to be found driving on any system, is condemnatory of the management.

Sheriff Strachan, in a judgment given at Glasgow on the 28th ult. (as reported in our "Traction Notes" of November 7th issue), made some sound remarks on the subject. He considered, among other things, that drivers should have a thorough knowledge of the mechanism of the cars, and should have them entirely under their control.

These seem to be such obvious qualifications for any driver to possess, that we might be pardoned for thinking that the Sheriff had a weakness for platitudes, until we read that the driver of the car that caused the collision in question had been trained "for about a week." This, coming from Glasgow, surprises us very much, and, without a full report of the evidence, we hesitate to believe that the week referred merely to the time the man had been actually driving a car in service; for we have always understood that Glasgow took up this matter of training most energetically from the beginning, and had established a school for the instruction of motormen on recognised American principles. Such a school was described and illustrated in our issue of April 26th, 1901, and we believe that the idea has been extended considerably on the other side. The school aims at giving every prospective motorman a thorough knowledge of the car and the equipment which he has to handle, by means of a skeleton arrangement which shows every cable and electrical or mechanical device on the car. Special instructors are detailed to explain everything, to drill the men in the handling of controllers, brakes, and sanding gear, and to examine them minutely after a certain period of training.

Many are weeded out during this process, but to pass successfully out of the school does not qualify an examinee for the position of motorman, and he has still to run the risk of rejection after a more or less extended trial on the road, during the whole of which time he is under constant supervision. Moreover, either before or after the period of schooling, every candidate is subjected to a searching medical examination, and immediate rejection follows the discovery of any radical disease, or of defective sight or hearing. We believe that the number of men who pass out as motormen does not exceed 50 per cent. of the applicants.

We desire to lay special stress on the medical examination, which we fear is enforced in hardly any of our British undertakings, though it would seem to be an obvious necessity.

Such a precaution would result inevitably in a reduction of accidents and of the sick list, and the men themselves

would benefit wherever sick clubs are supported wholly or in part by their weekly payments. The tramway undertaking need not be put to any expense in this matter of medical examination, for the first condition of employment should be that the applicant must pass through the hands of a specially appointed doctor at his own expense. This proviso would not only prevent undesirables entering the service, but, when widely known, would check to a large extent the number of such applicants, so lightening the work in the office.

The points we wish to press home in this article are that defective or inadequate brakes are rarely responsible for accidents; that a sadly large number of motormen are not really fit to be entrusted with the lives of the public; and that, indirectly, the management itself is responsible for accidents in which these incompetent men have a part, because it has not given them a proper education. If the full weight of this last point could be brought home to a manager on whose system a *fatal* accident occurs, we believe that he would never rest till he had tried to atone for his crime by bringing his men up to the mark.

King's College.

King's College, London, is one of the two institutions which, "for upwards of 70 years, without adequate endowment, and without the advantages of incorporation in any University, have supplied London with all that it has possessed in the shape of University education." Always struggling bravely to fulfil its high functions, always served nobly by teachers to whom no adequate remuneration could be given, King's College is now in debt to the extent of £35,000, and the Council is issuing an appeal for a sum of £500,000, which is the minimum required to place the College in a satisfactory working position as a school of the new teaching University of London. £265,000 is needed for the extinction of the debt, for new laboratories, lecture rooms, and libraries, and for their endowment; an income of £17,500, less the munificent Treasury grant of £2,300, and £1,000 given by the University for the endowment of the Chair of Engineering, is wanted for the Chairs in Science, Art, and Theology. It is difficult to conceive of an object which should appeal more strongly to Englishmen who have the welfare of their country at heart, than to assist in rescuing from pecuniary embarassments a college like King's. But it is still more difficult to understand how such an institution, situated in the heart of the largest and richest city of the world, should have been overlooked by our millionaires who are reputed to be constantly in search of some useful outlet for their surplus wealth, until it is compelled to appeal for funds to save it from insolvency, or from the alternative of a future diminution in activity. In every branch of knowledge, Englishmen of the present day owe much to the departed professors of the Strand. Sir Charles Wheatstone in electrical science, Clerk Maxwell in mathematics, John Hopkinson in electrical engineering, Daniell and Miller in chemistry, and one whose name, though absent from the list printed in the Appeal, will never be forgotten by students who had the privilege of working under his guidance—Charles Loudon Bloxam: this is the kind of men, in our department of science alone, whose lives were spent in the service of King's College, London, and whose attainments and conversation have fostered in some of us a feeling of affection for that place of study which can yield in no respect to the love of other Englishmen for the old residential Universities of Oxford and Cambridge. We can but earnestly hope that this £500,000—so small a sum when viewed in the light of its importance, and the benefactions of modern philanthropists to less worthy objects—will be speedily received by the Council; and that thus a phenomenon of poverty in educational facilities, which is a disgrace to the British Empire, may disappear from its capital.

A STUDY OF ELECTRICAL DEVELOPMENTS.

By VALENTINE RYAN.

To take a broad and proper view of a rapidly-developing industry is by no means an easy matter. To do so one must be intimately associated with that industry. Now those engaged in the electrical one usually allow a speciality to absorb all their attention; they confine their exertions to making preparations for a predicted development. Besides, they are rather disposed to depreciate the wonderful progress made during the last decade, simply because it will be outshone by the developments of the next.

Some six years ago an eminent professor lost no opportunity of impressing upon his students that all the existing electrical plant and apparatus in the generating stations would be obsolete within the next 10 years. If the students did not benefit by the changes somebody else would. To what extent the professor's forecast has been realised, is a matter for others to decide; however, it would be well if Messrs. Somebody could be induced, like the artist, to step back a few paces to obtain a better view of the few developments that are urgently needed and well within the range of possibility—for the present to lay aside what has been accomplished, and to consider a few of the more promising openings for enterprise which will present themselves in the near future. The writer must rest content with pointing out some of the things to be accomplished and defining the essential points that deserve consideration.

At present the lines along which developments tend are rather congested, so that one improvement is overlapped by another, but between these lines there appear to be equally promising, yet neglected, scopes for ingenuity. Usually one invention leads to another, so that a series of developments all tending in one direction are brought about within a few years. With many firms, once an article commands a ready market, developments are rather avoided than encouraged; this is due to their taking too restricted a view of the general effect and tendency of their work.

Plant and apparatus have been sold in large quantities for a few years, and have then fallen into disuse. This first fact alone has induced many firms to start in the electrical industry; even with the more established ones it has led them to repeatedly over-estimate the amount of trade done. The former seldom survive when required to adapt themselves to the new requirements; the latter err in this direction so often, that their losses and gains somewhat balance. They push things to extremes in one department; owing to good fortune it proves just then a move in the right direction. Encouraged by this success, the same policy is pursued again, with the contrary result. In passing, it may be mentioned that one flourishing electrical firm, with an immense capital, has never initiated anything. This firm has never possessed a master patent, but it has worked for months making preparations with a view to benefiting by the expiration of one.

Within the last few years some great developments have taken place. Certain foreign firms stepped in, and easily captured the markets; now they appear determined to hold them. On the other hand, many British manufacturers have raised their voices against the disadvantages under which they work. They plainly foresaw the coming developments, but discouraged by previous failures, they hesitated to prepare for them.

Every few years, as the electrical industry enters a new stage of its existence, the preconceived notions receive a sad, if not fatal, shaking. These existing theories are re-calibrated to meet the new conditions. This also leads to new wants and defects. These difficulties teach effects; effects suggest causes; a knowledge of causes leads to remedies. Then each manufacturer sets to work applying one of the so-called properties of the electric current to overcome the difficulty. One, grasping the essential points that are required to be fulfilled better than the others, directs his ingenuity in a more promising field. Thus he starts favourably handicapped, and attains an initial success. The others are disconcerted, rather disposed to over-estimate their opponent's triumph. The purchasers, considering themselves fortunate, treat their newly acquired acquisition with patience

and care. They never neglect to report its performance in ull. Thus all join hands in giving the manufacturer a gratuitous advertisement. In a rapidly-developing industry it is not always easy to avoid doing so; anything that tends to hasten its progress is quite rightly received with a hearty welcome. Yet because by the exertion of a limited amount of ingenuity a single property of the electric current has been directed and applied "for the use and convenience of man," it should not be too readily accepted as an established fact that any of the remaining ones cannot be utilised for the same purpose.

A striking illustration of this is afforded by arc lamps. Every week they are well represented in the list of new patents. With a few exceptions, the arc lamps in use consist of a number of ideas screwed together, forming anything but a uniform piece of mechanism. The object apparently is to embody in each lamp as many ideas as possible, seldom adapting the new ones to keep in phase with those already in use. It is too obvious that an author cannot embody all his ideas in a single play or novel. Yet mistakes in this direction are repeatedly made in arc lamps. Between the various movements employed for striking the arc and focussing the carbons there is very little to choose; so if the new one is reliable and uniform in its working it is as good as the best of those in use. No great plant or skill is required for this manufacture. Sometimes one may see them being made in the corner of a bicycle shop or warehouse. Purchasers are found in all quarters; some well-known firms turn out from 300 to 400 per week. A few patents and patent rights for the construction of arc lamps have been sold for £60,000. So there are many inducements and no impediments awaiting new starters in this field, yet it is surprising how closely their aims and objects are allied.

A successful lamp has yet to be invented without an electro-magnet controlling the movement of the carbons. In the case of enclosed arc lamps, the controlling current may be reduced so much that it would appear possible to use the heating property of the current by employing a hot wire to control the movements of the carbons. This method is liable to waste energy, yet if it could be utilised without doing so the simplest and neatest lamp possible would result. A modified plan appears very promising. This is to let the series coil strike the arc and lift the carbons, and so do practically all the work as in the existing arrangements. Then arrange an escapement controlled by a hot wire to feed the carbon; with a suitable arrangement the expansion of the wire need not necessarily be great. The wire might be arranged in any convenient form. Besides, as there would be only one coil in the lamp, it could be arranged concentric with the carbons.

The best illustration of the so-called properties of the electric current being utilised for the same purpose is afforded by electricity meters; to render the analogy more complete, one finds recorded almost all the names familiar to those engaged in the electrical industry.

Those instruments, while used for the same purpose, bear as little resemblance to each other as the stock-in-trade of an old curiosity shop. It is doubtful if those that have, so far, survived the test of time, were the best. These were fortunate enough to earn a reputation of not refusing to work. But this does not necessarily imply much for the accuracy of that work. With the more matured experience now available it might pay to revive some of the earlier forms.

Shrewd commercial men are prone to observe from time to time the idiosyncracy of their meters, and take advantage of it whenever possible. It is not surprising, then, that they do not countenance the changing of the meters. However, some of the essential points of a first-class meter are now well recognised:—(1) Iron castings used instead of tin cases. (2) The meter should be mounted in a casting hung vertically, say, 4 in. deep, thus forming complete protection from the wall. These important points ensure the meter remaining dust and damp proof. The old meters often considerably reduced the insulation tests of installations. It is not unusual to find the internal parts of them covered with dust, even when the cases appear to be well preserved. Besides, it should not be overlooked that meters do not lend themselves to being repaired, overhauled or even cleaned. They have rather to work for, in some cases, years, without receiving any attention. (3) The revolving element should be as light as possible, and move in a horizontal plane. In a particular meter this weighs only ½ oz. They always start readily with an 8-c.p. lamp; even those of 40 amperes capacity. (4) The registering gear should be in a vertical plane. To transmit the motion from one plane to the other worm gearing is generally employed. On examining the old meters it becomes evident that only two or three threads of the worm ever come in contact with the gear wheel. Again, the friction of the first train is transmitted in an increasing ratio to all the others, until finally it reaches the last in a much more magnified degree than when it started. To overcome these difficulties a simple counting gear is now being resorted to instead of the second train of wheels. This also facilitates meter reading. The first train then, may be said to be used to reduce the speed, and the second to count the number of revolutions. At present a single lever is used as a connecting link, and an independent ratchet allows the second gear to move in one direction only. A slight inaccuracy in the working of either of these may allow the meter to move and yet not register. Such a fault is liable not to be detected for some time; this point requires more attention. Both the lever and the ratchet require to be combined in a more complicated kinematic chain.

Electric bells have successfully monopolised a restricted field, yet they have undergone little modification in later years. The wooden boxes covering the movements entail a big percentage of the factory cost of the bells, but they do not affect the working. Grained enamelled tin covers resembling wood, similar to common tin trunks, would be much cheaper. Bells with 2½-in. to 4½-in. gongs made on this plan should prove very popular. Again, the projecting arm of the bell casting, employed for supporting the gong, adds to clumsiness and necessitates much labour. A conical iron stamping screwed to the base might be used instead. This would reduce the factory cost considerably.

It would be difficult to estimate the number of coils broken while they are being hammered on to the cores. The broken ones quickly disappear. A simple hand-press worked on the same principle as those used for light stampings would save a great number of coils in the course of a week's work. It would afford a steady and even pressure—all that is required. Even by simply damping the cores they drive on much easier.

In the direction of single-stroke bells, one must not expect too much. The ordinary electric bell vibrates, say, three to five times before it makes any appreciable noise. During this time the magnetic field is being built up while the armature and hammer are attaining some momentum. In single-stroke bells these preliminary vibrations are absent.

When multipolar dynamos and motors made their *début* their advantages appealed to all. In a few years they became universal. In the machine shop they wrought some radical changes. The big boring and turning mills just managed to keep pace with them. The side shaping machine with a pit in the centre was peculiarly adapted to planing the yokes. There appears to be a missing link as yet apparently unobserved; a machine for drilling and tapping the pole-pieces is alluded to. In a modern-size shop the pole-pieces are so numerous that there would appear to be ample work for such a machine. At present radial arm drilling machines are resorted to, and much time is lost in setting and drilling the poles. What really is required is a drilling machine consisting of two solid uprights with an arm across, like a planing machine, the space between these being large enough to just admit a large pole-piece, and no more.

These pole-pieces must be tapped true, or nearly so, which is not an easy matter, but an undue amount of time is wasted in doing this. Test a large multipolar machine with callipers and a straight-edge, and see if the pole-pieces are not, on the average, "out" from ¼ in. upwards; this tends to distort the magnetic field. With the field coils in position, this cannot be conveniently done, hence the errors remain undetected. If observed, a fitter and a labourer spend, on the average, half an hour on each hole; this means that the cost of tapping two holes in each pole-piece of a large generator becomes excessive.

There would appear to be no limit to the cost or complica-

tion of machine tools. As standardisation becomes more practical in the future, they promise to occupy such a predominant position, that the all-important fitter may rank as an accessory. So far, no properly organised method of providing light for the machine men has been adopted. An incandescent lamp is fixed in some convenient position—usually where it is not liable to get broken. More than this is required. It would repay to attach well protected wires on the machine and provide a few sockets, to any of which the lamp might be attached, a foot or two of flexible cord intervening between the lamp and the plug. A flexible wire with plugs at each end may be employed to connect this wiring to the main supply, so that when altering the machine to receive new work, it can be disconnected. This wiring might be said to resemble the tubes used for distributing oil in steam engines. These last three points are new deficiencies, which deserve more consideration from machine tool makers.

(To be continued.)

PNEUMATIC BRAKE TRIALS.

It is evident from the interest taken of late in this question, that the importance of suitable and adequate brakes on electric cars is at last being realised. The number of electric car accidents *must* be reduced, and this must be done either by the voluntary action of the tramway engineers and managers, or by the "Board of Trade"; which of these is the most desirable will be obvious.

The mistake of supplying insufficient braking power on electric cars in the past was perhaps a natural one, owing to the different conditions and lower speed of horse cars, but now we have, in the great number of accidents, undisputed evidence of the importance of efficient brakes, and neglect to give the question due consideration and attention must be regarded as a grave omission. The extra cost of good brakes must not be thought of, and even if this were permissible, can it be doubted that money spent on efficient brakes is a splendid investment, and that neglect to provide such is false economy?

The question of speed must, to a great extent, be regulated by the braking power on the car, and this is an important consideration when high speed suburban traffic is catered for.

The human element, which has to some degree been ignored, is most important, and a driver should be as much on the alert at the end of his shift as at the beginning; but this is impossible, due to two causes, viz.:—(1) Mental strain; (2) physical strain. The mental strain in driving a car can never be entirely eliminated, but a driver's consciousness of complete control of his car would do much to reduce it. The physical strain is due mainly to the heavy working of the hand brake, and it is strangely inconsistent that on any motor-driven car so much human energy has to be expended.

The importance of properly training the car drivers need not be insisted on here. It is dealt with at length in our leading columns to-day.

To reduce the human element of risk to a minimum, confidence must be created by having powerful brakes, and physical strain must be reduced by a mechanical service brake being substituted for the hand brake, the latter being used only as a standby.

In addition to the hand brake, therefore, there should be a brake or brakes suitable for emergency and service work, the emergency brake being preferably quite independent of the electrical equipment, and capable of immediate application; also it should not be a wheel brake, as the wheels would become locked and cause skidding, particularly on greasy rails, forming flats on the wheels, and greatly reducing the power of the brakes to pull up the car. For these reasons the emergency brake should be a slipper brake acting on the track.

The Hewitt & Rhodes pneumatic slipper brake, which has often been referred to in our "Correspondence" columns, is found, from actual test, to meet the above requirements. A description of it has already appeared in the Electrical Review.

On Thursday, the 13th inst., some tests were made at Stockport on a car fitted with the above brakes, at which a representative of the Electrical Review was present, and checked all the results obtained. These are given, for clearness, in tabulated form. The tests are divided under three heads, as follows:—

Emergency brake (1) on steep hill.
" " (2) on slight decline.
Service brake (1) on steep hill.
" " (2) on slight decline.
Ordinary hand brake (1) on slight decline.

The hill tests were taken on "Lancashire Hill," where there was a runaway car accident some time ago, and down which the drivers refused to run the cars unless other than hand brakes were used. Since the Hewitt & Rhodes brakes have been fitted to the cars, the system has been free from accidents.

Stockport Car Tests.

Table I.—*Trial of Emergency Brake on Steep Decline.*

No. of test.	Speed in miles per hour.	Gradient.	Distance pulled up after brake was applied.	No. of passengers.
1*	12	1 in 16	43 ft. 0 in.	8
2*	15	"	30 ft. 0 in.	8
3*	20	"	59 ft. 0 in.	6
4*	25	"	69 ft. 6 in.	6

* Lancashire Hill.

Table II.—*Trial of Emergency Brake on Ordinary Route.*

1A	27	Slight decline	56 ft. 0 in.	6
2A	25	"	63 ft. 6 in.	6
3A	22½	"	34 ft. 0 in.	6
4A	25	"	48 ft. 6 in.	6
5A*	20	"	50 ft. 0 in.	6
6A†	20	"	64 ft. 0 in.	6
7A‡	30	"	72 ft. 6 in.	6
8A	20	"	48 ft. 3 in.	6
9A§	17	"	29 ft. 0 in.	6

* Same route as test 1A. † Same route as test 2A. ‡ Same route of test 3A. § Same route as test 4A.

Table III.—*Trial of Hand Brake made for Comparison.*

1B*	17½	Slight decline	156 ft. 0 in.	6
2B†	19½	"	324 ft. 0 in.	6
3B‡	22	"	337 ft. 6 in.	6

* Same route as test 1A. † Same route as test 2A. ‡ Same route as test 3A.

Table IV.—*Trial of Service Brake on Steep Decline.*

1C*	5 approx.	1 in 16	24 ft. 6 in.	6
2C*	5 "	"	24 ft. 3 in.	6
3C*	5 "	"	13 ft. 0 in.	6

* Lancashire Hill.

Table V.—*Trial of Service Brake on Ordinary Route.*

1D	10	Slight decline	8 ft. 0 in.	6
2D	14	"	18 ft. 0 in.	6
3D	15	"	30 ft. 6 in.	6

Particulars of Car.—Weight of car, about 10 tons (empty); wheel base, 6 ft.; carrying capacity, 57 passengers; length of car body, 16 ft.; length over platforms, 27 ft. 6 in.; diameter of wheels, 30 in.; motors, two of 30 H.P.; reversed staircases.

Braking Equipment.—Hand brake acting on wheels. Hewitt & Rhodes combined emergency and service pneumatic slipper brake, connected pneumatically with the wheel brakes, an arrangement suggested by "Driver" in the "Correspondence" columns of the Review. A patent composition block, the patent of Mr. Atherton, was used on both wheel and slipper brakes.

Conditions of Tests.

1. The speeds were carefully estimated by means of a split-seconds stop watch and known distances.

2. The brakes were applied at given points, the distance the car travelled from these points being carefully measured with a line.

3. No sand was used on the track throughout the tests.

4. The condition of the track in all tests except those in Table IV. was fairly clean and dry; in the tests of Table IV. the track was slightly wet.

It was particularly noticed during the tests with the pneumatic brakes that the braking of the car even at the excessive speeds was very smooth, and there was entire absence of vibration. In the hand-brake trials the car jarred most unpleasantly, the vibration was excessive, and the action was accompanied by much noise.

As a service brake the action of the pneumatic brake was strikingly simple and easy, and there was no vibration.

The tests were carried out to ascertain exactly what could be done by this braking equipment under ordinary and extraordinary conditions of working.

THE MANCHESTER SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

The first meeting of the current session of this section of the I.E.E. was held on Tuesday last, November 11th. Mr. E. W. Cowan, who presided, explained that owing to the absence of the chairman, Mr. Earle, who was in South Africa, the inaugural address had to be postponed to the New Year; he hoped Mr. Earle would then have something of interest to tell them of electrical matters in that country. Through the kindness of the authorities, they were again able to hold their meetings in the Physical Laboratory at the Owens College; though a scheme originally suggested by Mr. C. H. Wordingham in his inaugural address last year, for providing central premises for the meetings and the combined libraries of the scientific societies of this district, was receiving the attention of leading gentlemen in the city. Mr. Goodrich then read his paper on "Electricity from Refuse; the Case for the Modern Destructor," to which we refer elsewhere.

A number of interesting views were thrown upon the screen after the paper had been read. Mr. Highfield opened the discussion. He insisted on the great importance of completely isolating the destructor and the electricity works when they are run in combination. The objections to the destructor are very great, but once these objections are recognised, there are advantages from the combination. He had not experienced any trouble from hot bearings due to the destructor, but found that the tubes of the condensers got blocked through the dust that had settled on the water in the cooling pond. With a combined destructor he found that the cost of cleaning the buildings, walls, &c., was greater. He thought that unsteady steaming would result from hand firing with a shovel, owing to the constant opening of the furnace doors and consequent cooling. He found that the men could get through double the work when pushed, and he had adopted a fixed wage and so much per ton burned, to overcome this difficulty. Good firemen were hard to get. No reference had been made in the paper to the difference in efficiency between steam and fan draught. It is important to note that the constant supply of refuse is interfered with owing to the men not working on Sundays and holidays, and this must be taken into account in estimating the value of refuse as fuel. Owing to the clinker sticking to the furnace walls, the cost of repairs was great; this had been reduced by using a new brick, which broke off in thin layers with the clinker. As the flues had to be cleared every week, it was necessary to have duplicate flues.

Mr. Cooper, of Colne, said that all the electricity generated in that town during the last six months, about 10,000 units, had been generated without using any coal. He thought the importance of a destructor was greatest at the commencement of an undertaking. It was not necessary, in clinkering the furnaces, to take out all the fire, and he found that clinkering half the grate at a time was satisfactory. In that town the Electricity Committee controlled the electricity department and the Health Committee the destructor. They did not experience much difficulty from wet refuse, owing to the ashpits and the carts that conveyed the refuse being covered. He objected to hand firing as insanitary. One point of importance to be considered was the wholesale introduction of gas stoves; in the future this might materially affect the value of refuse as fuel.

Mr. Meldrum pointed out the great importance of the use of the regenerator, particularly when wet refuse had to be dealt with; the point of ignition was more quickly arrived at, and a more constant temperature attainable, through the temperature of the air being raised to about 500° F. His experience was, that the best class of firemen for destructors were not coal firemen, who were, to some extent, prejudiced, but the agricultural labourer, who could more easily be taught to fire the refuse, and seemed to object less to the insanitary conditions. He thought there was no doubt of the superiority of the steam over the fan blast. The steam keeps the bars cool and prevents the clinker sticking to them. It had been shown that the actual power used to drive fans was about 14·3 per cent., the steam for Meldrum blowers working out at about 13 to 15 per cent. Why, then, provide the transforming plant, with its consequent cost, for driving fans? The trouble of the clinker sticking to the furnace walls had been mainly overcome by increasing the width of the side bars.

A number of other gentlemen also took part in the discussion. One engineer had had trouble with hot bearings ever since the destructor had been installed, and for about 200 yards around the works it was like walking on grit. He found the smell arising from the destructor almost intolerable, and his men had been off ill from this cause. The storing of refuse in a heated place must be condemned.

Another gentleman found that it was only possible to get a certain guaranteed temperature in the combustion chamber when the fan draught, which the consulting engineer had insisted on being installed, was replaced by steam draught. There were other systems of regeneration besides that explained in the paper, and one firm overcame the difficulty of the clinker adhering to the furnace sides by using iron plates.

Mr. Goodrich briefly replied to a number of points raised, after which a hearty vote of thanks was accorded to him for his paper.

ENGINE AND BOILER BREAKDOWNS.

Equally interesting with the electrical portion of Mr. Longridge's report for 1901, to which we referred some weeks ago, is the part which deals with steam-engine failures.

Of the total breakages for which the Insurance Co. paid compensation, only 31 per cent. were due to the combined causes of old defects, and wear and tear.

No less than 23 per cent. were due to bad design and construction, including weakness. The same proportion arose from negligence, and the same again from causes not ascertained, or accidents. The seat of first breakage was chiefly in the valve gear or valves—56 per cent. Cylinders, valve chests or covers came next with 26 per cent., but probably spur gears with 22 per cent. are really second, for every engine has a cylinder, while spur gears are less common, and in the past have come a very near second to valves. Indeed, the breaking parts which appertain to old type engines, become fewer as modern engines come into vogue, and we are not surprised to see the proportions of failing parts undergoing gradual change.

A high-speed engine was smashed up by an internal relief valve getting adrift. A gas engine failed by breakage of a connecting rod big-end bolt.

The cast-iron crank of a beam engine burst in the eye apparently through expansion of the shaft, owing to a heated main bearing. It is pointed out how unsafe it is to run a cast-iron crank next a hot bearing, when the crank eye will be stressed by shaft expansion. Cast-iron cranks are scarcely likely to be repeated to-day. In the old days they seemed to give very good results, and to stand being shrunk on to shafts, which also were of cast-iron, as lately as 30 years ago, the advantage of this metal being its cheapness and its excellent wearing qualities in a gun-metal

bearing. These cast-iron shafts were always cast vertically in a pit, with a big head to catch cinder and ensure sound casting.

The danger of hot bearings was further shown by the fracture of a forged-steel connecting rod big end when the crankpin was running hot.

A not uncommon accident was the fracture of a gas engine cylinder on account of scale deposited in the jacket from hard circulating water, for removal of which jackets ought to have mudholes. These jackets are often found to freeze in winter, and ought to have drain cocks for drying them out at night, or at the week-end more especially.

The beam of an engine broke with a stress of some 6,700 to 7,700 lbs. per sq. in., so that the total range of stress was about 14,000 lbs. + and −, a stress safe for a new beam, but not permanently so, a sufficient number of reversals alone being necessary to cause fracture.

Six particular examples are given of parts which failed with an ascertained number of stress repetitions. The first was a wrought-iron shaft, which made 72 million revolutions with a stress of 7,500 lbs. at the dead centre, and 6,200 lbs. at half stroke, followed by 41 million revolutions with 6,200 and 7,000 lbs. respectively at dead centre and half-stroke.

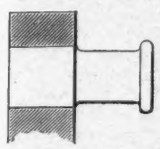


Fig. 1.

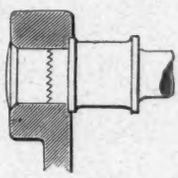


Fig. 2.

Both necks failed by gradually breaking up. In a second case a mild steel shaft stood 214 million revolutions with a stress of 10,000 lbs. on the dead centre, and 10,700 at maximum turning moment. With 264 million revolutions a mild steel shaft failed at 5,500 and 6,600 lbs.

Another shaft, of Whitworth compressed steel, with stresses of 7,800 and 8,200, rolled off 270 million revolutions before failure. In all these cases the range of stress was not far from the figures given, the minimum being practically zero.

Of two other cases of reversed stresses, in one case a crosshead with a range of 15,000 lbs. failed at 191 million revolutions; another one failed at only 24 million revolutions under a stress of 22,000 lbs. range. A Whitworth steel crankpin made 304½ million turns before failing at 13,500 lbs. stress per sq. in.

The failure of crankpins is again made the occasion of pointing out the correct way of fixing pins, with the part inside the crank larger than the pin itself, as in fig. 1, and not as in fig. 2.

An engine failed from the ease with which water could flow 70 ft. from the condenser to the cylinder, the exhaust pipe having only 1½ in. fall. When the air pump failed, water accumulated quickly and entered the cylinder. This accident would probably have been prevented had the exhaust pipe been even 1 ft. below the cylinder, for the pipe would have become full of water, and would have shut up so much steam in the cylinder as to have kept back the water, if indeed the steam did not force back all the water to the pond.

The value of Mr. Longridge's method of stating the number of stress repetitions causing failure is undoubted. It is also evident that he has an appreciation of the principles which lie at the base of what has become known as Wöhler's law of stress, but which was fully appreciated by Fairbairn and Hodgkinson, and must be taken into account if safety is to be ensured. The fatigue of metals possibly does not occur where the range of stress is kept within certain limits, dependent upon the nature of the stresses and their fluctuations between minimum and maximum, plus or minus values.

In respect of boilers, attention is drawn to the incorporation in the Factories Act of 1901 of the rule that a boiler must be inspected by a competent person at least every 14 months. The idea is to allow a margin above the annual examination period of 12 months, but Mr. Longridge thinks that 15, or even 18, months should have been allowed to cover the practical difficulties which prevent an annual period being adhered to. Inspectors must certify to the boiler being properly prepared for examination, a clause which will enable them to resent those perfunctory red hot kinds of preparation indulged in by some steam users who do not themselves take a personal interest in their steam plant.

Some examples of faulty boilers are cited. In one instance a Cornish boiler built up in inaccessible brickwork was found after nine months of correspondence to be so badly corroded outside as to be unfit for further use.

The thought suggests itself as to the results of an explosion occurring during the long period of correspondence, and as to the responsibility of the owners who took the risk during that time. Other defects noted of corrosion, overheating by grease, and defective safety valves, all point to the fact that even after 48 years the inspection of steam boilers is neither universal nor wholly popular, nor do boiler owners realise the trouble they are likely to bring upon themselves by taking the very serious risks of working a badly corroded boiler or a suspected boiler after an insurance company has urged the danger.

During the year 1901 the mishaps and fatalities exceeded the average for the previous 18½ years very largely, apparently in the category of miscellaneous mishaps. No insured boiler exploded during the year, and only four lives were lost owing to boiler mishaps for which any insurance company was at all responsible. It is noteworthy that three of these lives were lost by failure of single tubes in water-tube boilers, owing to overheating. It is desirable to point out that, if there is lap-welded tube with the smallest imperfection, it is almost certain to fail if the tube becomes incrusted; that solid drawn tubes are alone fit to be employed for water-tube boilers; and that water-tube boilers of the ordinary type are as liable to incrustation as are shell boilers.

It is well known that boiler touts will claim that the circulation is so rapid that the tubes of their particular boiler become scoured out and clean. The hottest part of a Lancashire boiler is the furnace crown, and this, it is well known, gathers scale with difficulty. Scale tends to split itself off the outside of a heated tube, but it cannot separate off the inside of a tube. The tubes of a water-tube boiler ought to be carefully examined for scale, and bored out when necessary.

An electric light can easily be passed through a tube to render it visible, and its clear diameter is easily gauged by means of a series of discs screwed to a length of ⅜-in. gas-pipe.

ELECTRICITY FROM REFUSE: THE CASE FOR THE MODERN DESTRUCTOR.

The above is the title of a paper read before the Manchester section of the I.E.E. on the 11th inst. by W. F. Goodrich, A.I.M.E. From a perusal of the paper we conclude that the author regards as synonymous the terms "Modern Destructor" and "Meldrum Destructor," as the contents deal chiefly with the results obtained with this particular type. We do not complain of this, as it was obviously the intention to put forward the best possible case for the refuse destructor from the standpoint of steam generation, and, so far, Meldrum's holds the record.

The destructor of, say, 15 years ago, was essentially a low temperature one, the gases in the main flues ranging from 600° to 800° F.; whilst in the most modern forms the temperatures reach from two to three times these values.

Not only does the higher average temperature mean efficient destruction, and absence of obnoxious smells—features which could not be claimed for the earlier types—but the more perfect combustion of the refuse places the destructor in the position of being (under favourable conditions) an economical and efficient steam raiser when worked in combination with a high pressure boiler.

The cellular arrangement of destructor, in which each cell is, so to speak, "on its own," has not, in practice, given such good results viewed from the steam raising standpoint as what might be called the "co-operative" system, in which the cells act to some extent in combination.

Mr. Goodrich condemns, and we believe rightly so, the system of placing one boiler between two cells. It is bad, obviously bad, from both the cremation and steam-raising aspects, and we agree with him that continuity of high temperature within the furnaces should be the first aim. This assured there need be no misgivings as to the possibility of "green" gases passing over into the flues to be discharged in noxious fumes into the atmosphere. Further, by maintaining a uniformly high temperature in the furnaces the variations in steam pressure in the boilers will naturally be less than if hot and cold gases are passed into the flue, there to co-mingle and to equalise.

As the Meldrum destructor was recently described in these columns, in the articles to which Mr. Goodrich refers, repetition is unnecessary here. The author strongly disapproves of the mechanical charging of the furnaces, as, besides causing wide temperature variations, and consequent imperfect combustion, by dumping into the furnaces large masses—30 to 45 cwts.—of cold refuse, the cost of labour per ton is from 30 to 50 per cent. higher than for manual firing. Nor has the author experienced any difficulty in finding men for this class of work. He says: "Although one would scarcely expect to find a Mark Tapley charging refuse, yet it is common to find a cheerful energy in the destructor house, which is too often wanting in the ordinary stokehole. It is, indeed, curious, and almost unaccountable, to find men uncomplainingly doing their level best with refuse, while others, who are provided with good coal to burn, are found in a state of chronic passive blasphemy." Why "*passive*" blasphemy? Possibly the cheerful destructor men referred to are those at St. Helens, where they make so much money at £1 a week, plus ½d. a ton, that they take Saturday night off to spend it in raising the average consumption of beer. This, at least, might be inferred from the remarks of Mr. Highfield, who did not, however, say if there was more blasphemy in the engine room on Saturday nights, owing to erratic behaviour of the steam pressure gauge, or in the neighbouring "bar," due to the high temperature of the stokers.

In Great Britain there are, at the present time, 160 destructors, of which 45 are combined with electricity works and 26 with sewage works, the Meldrum types being represented by 24 and 14 respectively in the two latter numbers. The combined destroying capacity of those in electricity works is put down at 1,400 tons a day. As the author considers 30 units of electricity per ton of refuse a safe average figure, a simple calculation gives us 15,330,000 units as the quantity of electrical energy annually raised from refuse. It would be interesting to learn the actual figures.

It is important, in giving results, either of special evaporation tests, or of savings effected, to give all the data, or, when this is not possible, to point out that certain allowances or deductions should be made. Thus, the author shows that at the Darwen electricity works, 2,520,000 gallons of water were evaporated in one year from 10,000 tons of refuse, effecting a saving of £1,050 in the coal bill. The natural inference is that £1,050 had been saved by the combination of the electricity works with the destructor. But it must not be overlooked that about 2s. a ton (or more) should be debited to the destructor plant for stoking and standing charges, giving the respectable sum of £1,000 to set against the cost of coal firing. Then in the extract from the evaporation tests made at Nelson, nothing is said as to what percentage of the steam raised was used for the forced draught. Nor do we find anything in the paper referring to this important point. It is by no means a negligible quantity, as it varies from 15 to 40 per cent., depending upon the type of furnace, and possibly on the nature of the refuse.

The Nelson figures are probably the best ever obtained with refuse as a fuel; we refer to the emergency test of eight hours' duration.

The evaporation from and at 212° F. was 1·96 lbs. per lb. of refuse, and the effectiveness of the combustion may be gauged from the fact that the percentage of CO_2 in the flue gases was 14·4, and the average temperature in the combustion chamber was 2,227° F.

In a test made at Lancaster the corresponding figures were 1·63 lbs. and 15·5 per cent., and over 2,000° F. (by copper test).

What always impresses us in the Nelson results is the very high rate of evaporation, viz., 13,442 lbs. per hour, from and at 212° F. This, with a 30 ft. × 8 ft. Lancashire boiler, is a figure not easily beaten, even with coal firing. It can no doubt be done with forced draught and mechanical stoking, but, nevertheless, it is a high figure. In this connection it is interesting to note in the paper under discussion that the Lancashire boiler appears to be a better steam raiser than is the water-tube type when fired with refuse. The relative values are 1·866 to 1·438; in other words, the Lancashire boiler evaporates 3,732 lbs. per ton against the water-tube boiler's 2,876.

The discussion on the paper did not add much information on the general question, but the consensus of opinion appeared to be in favour of manual firing, and separate buildings for the destructor and generating station, so as to minimise dust and "stink" nuisances.

CORRESPONDENCE.

The Purification of the Atmosphere by High Voltage Electricity.

The description of the apparatus patented by Mr. J. Harris and applied by the Atmospheric Electric Purification Co., Ltd., which appeared in your issue of the 7th inst., so closely resembles the apparatus patented by Messrs. Thwaite and Gardner (No. 15,684, 1896), for cleaning combustible gases, that a short comparison may be interesting.

Referring to the illustration from Mr. Thwaite's patent specification, "In chambers C and C^1 are suspended oblique screens F and F^1 . . . Each of the screens F or F^1 consists of two parallel webs of wire gauze. . . . . In order to ensure more rapid and complete deposit of dust, it is preferred to provide to and along the screens insulated conductors with points by which electrical sparks may be passed through the dust laden gases, these sparks having the known characteristic of causing rapid deposit of suspended particles. Each of the wires that is connected to the one terminal of the electric generator having its points projecting from the one web of the screen, has directly opposite to it a point of wire connected to the other terminal, so that whenever suitable contacts are made externally a number of sparks pass from one set of points to the other set."

The electrical discharge being of high voltage, the sparking was of the brush discharge type, the gases to be cleaned being passed through the chambers by means of a fan. The peculiar manner in which the dust is thrown down by this apparatus is very striking and effective.

Spark-Gap.

Students' Difficulties.

I wish to say with regard to the much-discussed question of "Students' Difficulties" published in your valuable journal, that I heartily agree with your correspondent "Last Lap" in saying that the electrical student should have two years in mechanical workshops, two years in electrical workshops, and two years of electrical theory in a good technical college. This course of instruction, to my mind, is without a question of a doubt, the *correct* and only course; and it is, in fact, the exact course which I marked out for myself, the only difference being that I put the theoretical electrical course between the two other courses, as follows:—Two years at mechanical workshops, two years at a technical college (*theory* and *practical* electricity), two years at some good electrical works. The student should, moreover, be constantly reading the best electrical text-books, view various power stations, and *work* diligently.

If he intends to work hard, he will find it more profitable to work as a *pupil*, instead of as an *apprentice* in

works. The reason is obvious, as a pupil can leave a job when he thinks he knows enough about it; but he must remember that he must work hard, as it is to his ultimate benefit that he should do so.

D. R. Broadbent.

39, Hyde Park Gate, S.W.,
November 14th, 1902.

Renewal of Electric Lamps.

We noticed a week or two ago an article on the question of electric lamp renewing. We beg to enclose our circular for your perusal, and we think that this in some measure is a way out of the difficulty.

Lamps are changed once every three months, and those lamps which are brought back are tested, and lamps taking more than four watts per candle and not giving the proper candle-power are rejected and new supplied in their place.

Though this is not actually a free renewal, it comes very near the mark, and we find that there are very few complaints *re* bad supply.

Of course, profit is made, not on individual subscribers, but on quantities.

We should be pleased to hear through the medium of your paper as to whether there are any firms in London that offer these advantages.

The London Electrical Installation and Maintenance Co.,
pp. J. Stewart Gunther, *Manager.*

1, Skinner Street, Bishopsgate, E.C.,
Nouember 17th, 1902.

Municipal Trading.

There is a remark in your last week's issue by which you suggest that the public feeling against municipal trading is represented in the defeat of Lord Provost Chisholm at the Glasgow Municipal Elections. May I ask you to be fair and tell your readers who defeated him? *Not* a member of any Industrial Freedom League, or an enemy of municipal trading, nor a representative of vested interests, but an out-and-out Socialist who is a still more advanced man as regards municipalisation than the man displaced. Otherwise, you *might* justifiably have argued that the Lord Provost's defeat was a blow to municipalisation.

Fair Play.

Artistic Radiators.

Might I trespass on your valuable space devoted to "Correspondence" to ask if any of your readers could inform me of a Paris or London house where I could obtain artistic radiators such as were exhibited at the last Paris Exhibition?

I should be glad to forward anyone interested in the above a rough sketch showing the article I require.

S. E. Fedden.

Sheffield Corporation
Electric Supply Department,
Sheffield, *November 17th*, 1902.

Tramcar Brakes.

During the last seven years I have been intimately connected with the operation of electric cars, and I think that the human element is one that is not looked to enough in the question of brakes.

The most efficient brakes can be fitted, and come out splendidly in the tests, but in an emergency they are either not handled right or fail to act. With a runaway car the motorman is not capable of doing more than one thing, and if this fails, it is too late to try again. What does the motorman do when his car begins to get out of control? the most natural thing in the world—jams on his hand brake as hard as he can get it. If the rail is at all greasy, as in town lines is usually the case, he skids his wheels, thereby rendering inoperative all his brakes dependent upon the revolution of either his wheels or armatures. The emergency brake wanted, in my opinion, is a powerful slipper brake, operating directly on the track, and worked, not by a hand wheel, but with a lever, this lever engaging in a quadrant with only one catch to hold the brake in its most powerful position. At the same time, this lever should be constructed so that, when pulled forward, it opens both sand hoppers on to the track. Then the motorman does not have to worry about his pedal, which has a nasty knack of getting jammed when jumped on, and, in the moment of excitement, is sometimes forgotten. This brake would have the advantage that the conductor could use it in the case of a run-back, or to assist the motorman in the case of a runaway.

R. Humphries, A.M.I.E.E.
Engineer and Manager.

Isle of Thanet Electric Tramways
and Lighting Co.

Current Supply for Cinematographs, &c.

Mr. Turnbull's suggestion to take current from outers and transform, is doubtless the best remedy for such troubles. However, it is hardly fair for him or others to grumble at their consumers not installing such machinery. The apparatus would be solely for the benefit of the supply authority, and in that case they should provide it. The consumers use, and pay for, energy supplied to them, and it is certainly no business of theirs what the distribution system is, or how the station is run. It seems to me that a lot of station engineers hold the idea that "instead of running their station to supply their consumers with energy," "their consumers use energy for the running of their station." May I offer the following suggestion, &c.:—At a theatre here we run a hand-fed lamp taking about 30 to 35 amperes with a voltage of 90 to 95 across the arc (high certainly). Entertainers inform us that we obtain for them excellent pictures, in fact, as good as they get anywhere (lantern being about 80 ft. from sheet). We take current from one side of a 230—460-volt three-wire system through liquid resistances made up for the occasion. You could lessen your trouble by using a resistance (preferably liquid) having a large range, and providing it with gear that will enforce it being cut out slowly.

Such an arrangement can be easily rigged up, or you can obtain a "Lyons" resistance, which would probably answer equally, providing it with necessary gear.

We have had the Supply Co. on our track but once, when using minus gradual application. We will write Mr. Turnbull if he so desires giving particulars.

Blake.

Weston-Super-Mare.

Large Steam Turbines.

We notice in your article of November 14th, page 107, a description of a two-cylinder turbine built by the Westinghouse Co., of Pittsburg. As, from the description and illustration, it would seem to closely resemble two 1,250-KW. plants built at these works for the Corporation of Elberfeld, and set to work in the spring of 1900, we think a description of these plants may be of interest to your readers.

It will be noticed that, in these plants, the expansion is carried out in two cylinders coupled together, and driving the shaft of the dynamo. At the time we received the order, in 1898, and put the work in hands, we had had no experience of the working of so large a cylinder as would have been involved had the whole of the expansion been carried out in a single cylinder, and to avoid unforeseen difficulties the cylinder was divided, the high pressure cylinder expanding the steam from 140 lbs. to a little below atmospheric pressure, and the low pressure cylinder completing the expansion down to a vacuum of 28 in. with barometer at 30 in. These plants were very successful, the consumption at full load being 19·43 lbs. per kilowatt-hour as against a guaranteed consumption of 24 lbs.

The tests on these machines were very elaborate, and were carried out by Mr. W. H. Lindley, M.I.C.E., consulting engineer to the Corporation of Elberfeld, assisted by Prof. Schröter and Prof. Weber. To meet the wishes of some of

our Continental friends, we carried out tests upon the benefit of intermediate superheating between the high and low pressure cylinders. The result of these tests was that the benefit of the intermediate superheating was negative, *i.e.*, that there was no gain by the use of the superheater within the errors of observation of a series of most careful experiments. On thinking the matter over, we realised that such a result was really in accordance with theory, as the bulk of the heat absorbed by the intermediate superheater was utilised in evaporating the moisture in the exhaust steam of the high pressure steam turbine, this degraded heat being, in other words, utilised in generating steam for the low pressure turbine, or a very wasteful way of using the heat; the remainder of the heat, on the other hand, was used for superheating the steam. This, theoretically, was useful and economically applied, and the conclusion arrived at was that the gain on one side just about balanced the loss on the other.

Since these engines for Elberfeld were constructed, our designs for turbines of 1,000, 2,000, and up to 5,000 KW. output have placed the whole of the power in one cylinder. Our experience with official tests of one cylinder turbines of the same output as the Elberfeld plants have shown a gain of about 10 per cent. over the result obtained with the double-cylinder type.

C. A. Parsons & Co.

MECHANIC.—We have received a letter over this *nom de plume*, without the name and address of the author.—EDS. ELEC. REV.

LEGAL.

FERRANTI *v.* THE BRITISH THOMSON-HOUSTON CO., LTD.

THIS case came before the Court of Appeal, composed of Lords Justices Vaughan-Williams, Stirling and Cozens-Hardy, on Thursday last week, on the appeal of the plaintiff, Mr. S. Z. de Ferranti, from a decision of Mr. Justice Swinfen Eady in the Chancery Division, dated January 30th last, giving judgment for the defendants. The judgment was reported in our issue of February 7th, 1902.

Mr. CRIPPS, in opening, stated that the action was one brought on a patent involving the question of validity and infringement. As regarded validity, the decision of the learned judge was in their favour, and granted them a certificate that the question of validity had been in dispute, and that he had found in the plaintiff's favour. As regarded infringement, he held that in the construction of the patent there had been no infringement by the defendants. It would be seen, therefore, that the question before their Lordships was a comparatively short one. The subject matter of the patent was what was known as a motor meter for measuring the electricity supplied. There were various forms of meter, some chemical and some clockwork, but by degrees the only form of meter which came to be used was the motor meter, with which they obtained the measuring force from the current which they were supplying for the purposes of consumption. In this particular branch of electrical science, Mr. Ferranti had been the pioneer, but the particular patent with which they had to deal, was one for improvements only upon an earlier patent which Mr. Ferranti brought out four or five years ago. He was glad to say that in the present instance they had not got the Hookham case over again, and that the matters in dispute were very much more confined than in that case. The learned counsel then referred their Lordships to a series of diagrams, and said there was a meter which was invented by Mr. Ferranti in 1883. The current went from the dynamo through what was called a moving field. Then it went on through coils which formed the magnet, and proceeded in the direction of the lamp currents, from which the current was taken for the purpose of lighting. All these matters depended upon what was called interaction between the moving field and a stationary field of electric force, and so in the meter they had the moving part of the mechanical contrivance and they had the stationary field, which was constituted by an electric magnet. That was, in itself, theoretically an absolutely perfect meter, and by putting on a dial, they ought to have obtained a perfectly accurate measure of the current supplied to the consumer, and so ascertained exactly what the consumer would have to pay. But there was one practical difficulty in the way. Of course, in all mechanical contrivances they had to contend with some element of friction, and although this meter was theoretically a perfect machine, yet the element of friction was bound to come in. It did in this case, and the unsatisfactory part of the machine was that it did not start quite quickly enough, and perhaps when a small load was on, it would not start at all, because there was some slight friction to overcome. It was quite obvious that as between the engineer on the one hand, and the supply company on the other, this was not a satisfactory state of things, and for years Mr. Ferranti studied the problem so as to get some method by which this slight friction could be overcome. When he told the Court the solution it would appear a very simple one, but it was a very complicated problem, so far as electricians were concerned. What Mr. Ferranti ultimately did was this. He reinforced by a constant factor the power of the stationary field. He took what was called a shunt current; he took it off his positive main and wound it round the top of the standing field of the electric magnet, it then being brought back to the main return current, so as to go back in the direction of the dynamo, or to go to earth. What Mr. Ferranti wanted was an additional constant factor in what he called the stationary field, which would correct the difficulty which had arisen owing to the friction either in starting the machine or when there was a light load, and the only thing that was necessary was to obtain that constant factor which, as they said, was derived from a shunt current outside the lamp current. In other words, they must obtain it outside the current which was going to be measured, and it would therefore be seen that any expenditure in making the machine perfect would be the expense of the supply company. The invention, therefore, of Mr. Ferranti was the re-inforcement of the stationary field by a constant factor outside any immediate influence upon the lamp currents. Mr. Ferranti said that invention was applicable to all motor meters. Turning to what the defendants had done, it would be seen that their motor was what was called the wattmeter. It was a motor meter just as much as the plaintiff's, but it measured both pressure and current. Now, in order to get the wattmeter, it was necessary to have what was in the nature of a shunt current, and in the machine was a little coil which had exactly the same effect or general influence as the coil which was invented by the plaintiff for giving a constant reinforcing power to the stationary part of the magnetic field by a constant factor independent of the lamp current. *Primâ facie*, therefore, the two things were exactly the same, and the only suggestion made by his learned friend, Mr. Moulton, was that the defendants' meter did something more. Even supposing that to be the case, he submitted that it did not affect the question of infringement at all. As a matter of fact, they had got exactly the same device in the two coils for exactly the same purpose, and the only difference was that the mechanical structure and electrical parts of the two meters were slightly different. It was true that in applying the plaintiff's invention to their meter the defendants got certain minor differences, but to his mind that was perfectly immaterial. The main purpose for which they had taken it was exactly the same as the main purpose of the invention itself, viz., to get a reinforcing constant factor outside the lamp current in the stationary magnetic field. The question was whether the plaintiff had, as a matter of fact, so drawn his specification as to exclude what had been done by the defendants, and in effect what the learned judge in the Court below decided was that, instead of claiming the invention as they said as applicable to all motor meters, it had been made applicable to all motor meters, but specially excluded the method in which the defendants had applied what was, no doubt, the plaintiff's invention. He did not think that was the right construction, but that, at all events, was the substantial point which would have to be considered. The learned counsel then read the provisional and complete specification of plaintiff's invention. He said there was no difference between the provisional and complete specification. Motion was given by the lamp current to be measured to the mercury. The electric current being sent through it caused the mercury to revolve round and round, and it carried with it a disc, and the extent to which that revolved was shown on the face of the clock, which recorded the exact amount of current taken by the consumer or customer. The defendants' was admittedly a motor meter.

Lord Justice V. WILLIAMS: You get your additional force by tapping the current to be measured before it begins to be delivered to the customer?

Mr. CRIPPS: Yes. The current that is so tapped and passed from the shunt path is practically only a small amount, therefore the loss at the generating station is not a big matter, so far as the supplying company is concerned.

Lord Justice V. WILLIAMS: Having tapped the current, you have this coil, and that binds round one end of the electro-magnet above the blue; is that right?

Mr. CRIPPS: Yes.

Lord Justice V. WILLIAMS: And in "D" is not above the blue but at the side of the blue?

Mr. CRIPPS: Yes; but that does not matter, so far as the electrical question is concerned. The reason of wrapping round is to increase the area of your field; you wrap it round a number of times, to the extent to which you want your reinforcing power.

The learned counsel, continuing, said that there were two points on which the learned judge had found against the plaintiff; one was the limiting current, in the sense that the defendants were not infringers because theirs was an energy as contrasted with a current meter. That was one point of Mr. Justice Swinfen Eady's judgment. The other point was this: the learned judge seemed to have thought that it was desirable or essential for the working of the plaintiff's invention that the shunt current—that was the current going from the positive to the negative main—should not go through the mercury, and the plaintiff's direction was not that it should go from one main to the other, but that it should not go through the mercury bath. Apart from the construction of the words themselves, which the plaintiff said did not bear that meaning, it was as Mr. Swinburne had said, viz., that so far as the plaintiff's meter was concerned, it was not material whether it went through the mercury or not, the material part being that it was outside the lamp circuit. The plaintiff's claim in the specification was exactly in accord with what he stated in the body of the specification. The question to be asked, was whether there was anything in the specification which cut down the general character of claim 1. He answered that by the saying "nothing without you did what

the learned Judge had done," viz., taking the illustrations as though they exhausted the whole ambit of the plaintiff's invention. The learned counsel then proceeded to read the judgment of the learned Judge in the Court below, during the course of which he remarked that the action was a very important one, because if the plaintiff succeeded in the action, he could prove that his invention had been adopted in probably every successful electricity meter in use. If the learned Judge's construction was right, it would lead to a strange result. Supposing some one came along and took Ferranti's meter with the mercury bath in it, and did what was quite immaterial electrically, and took the shunt current from main to main, and took it through the mercury bath instead of round the top outside, according to the learned Judge's construction, that would not be infringement, because, as he said, Mr. Ferranti had told the world not to do it. As a matter of fact, the plaintiff's was the pioneer invention in making these motor meters commercially practicable.

At this stage the further hearing of the case was adjourned.

Mr. Cripps, continuing his address on Friday, said that before dealing with Mr. Justice Swinfen Eady's judgment on the question of construction, he wished to point out that even assuming the limited construction put by his Lordship on the plaintiff's specification were the proper construction, it was clear he had misinterpreted the question of infringement owing to a misapprehension of the scientific evidence in the case. What his Lordship, in fact, said was that what the defendants did in taking the shunt current through the armature was what the plaintiff had said was not to be done. The expert evidence called by the defendants was that the armature in "C" was not in any sense equivalent to the mercury bath in the plaintiff's meter. On the scientific point in the case he thought that both plaintiff's and defendants' experts agreed. Mr. Ferranti with regard to a mercury meter with which he was dealing specially, thought it was better, and he so directed that his additional coil should be placed in such form as that it should not go through the mercury bath. That probably was, scientifically and theoretically, the best thing to do. As he understood the argument of the other side was this, viz., that as the additional coil—which the plaintiff said was taken from him—not only served the purpose of the plaintiff's invention, but applied to an energy meter which did something else—which the plaintiff could not help it doing—it was not infringement.

In answer to Lord Justice V. Williams, the learned counsel said that the real question as regarded infringement was whether defendants applied Mr. Ferranti's invention to "C." In "C" there was a shunt current, which had nothing to do with "A" and "B" at all for the moment. It was a different form of meter for the purpose of his argument. Now what did they do? Having "C," which had undoubtedly got a shunt current, and feeling a difficulty, which the plaintiff felt, of not having a stationary field strong enough, they (defendants) took the plaintiff's coil to reinforce their stationary field. That was exactly the plaintiff's invention. The additional coil to reinforce the stationary field performed exactly the same purpose in each case, viz., that it reinforced the stationary element.

Lord Justice Vaughan Williams: Does not this go back to the question of construction? The learned Judge says: "What you say in your patent is—I intend to intensify the blue, but mind you, it must not give a twist to the mercury by passing through the red."

Mr. Cripps: What the learned Judge says, and where I think there has been misconception, is this. He said: "You told the public not to take the red through the mercury bath. You said you were not only to take it direct from the mains, but you were not to go through the mercury bath." Supposing that was the proper construction of the patent, let us see what "D" does. "D" does that exactly, because the rotary part of "D" is not in any sense equivalent to the mercury bath in "B." It has nothing to do with it. Mechanically you get the rotary element, and so on; but electrically—as Prof. Ewing said—you are not dealing with equivalent matter. Supposing you had this limited construction, not to take it through the mercury bath, they do not do it. The learned counsel, continuing, said that his argument was that really they had nothing to do with the question of difference between the meters, except so far as it affected the point on which the learned judge found against the plaintiff on the question of infringement. The plaintiff's invention was the additional coil reinforcing the stationary part of the magnetic field. The defendants did that. The coils they used in "D" did that and nothing else. If he (counsel) was right that the plaintiff's invention was in having this additional coil, it was clear that the defendants had taken it. The only difference was in defendants having applied it to an energy meter. Defendants, he submitted, were not entitled to do that and say they were not infringers. The defendants' difficulty was the same as the plaintiff's. They found that the stationary part of their field wanted reinforcing, and they took the plaintiffs' invention for the purpose of the reinforcing of the stationary field. They did not alter plaintiff's invention at all. What he (counsel) wanted to make clear was this—giving full weight to what was a scientific difference between them, viz., the difference between the two meters, the effect of the additional coil—which the defendants had taken from the plaintiff—on the stationary field was the same. The additional coil performed the same operation in the one case as in the other.

Lord Justice Stirling: The question is does the patent cover that.

Mr. Cripps submitted that it did. But even upon the narrower construction, he submitted he was right as regarded infringement. What his Lordship (Mr. Justice Swinfen Eady) had said was this. He said: "On the narrower construction of the patent you said not only is the red or shunt current to go from main to main, but it is not to go through the mercury." That was his Lordship's construction. Now where he had made a mistake was this. He said that in "D" it was true defendants went from main to main—that could not be questioned—but he said they took it through what was the equivalent of the mercury, or in other words that the defendants did what the plaintiff directed the public not to do. Now the answer to that was this; it seemed to him to be a conclusive answer, because it was what defendants' own witnesses said—that the rotary part in "D" was not in any sense the equivalent of the mercury bath in "B." On the question of construction, the learned counsel submitted that the plaintiff's claim was not limited to a mercury meter.

Lord Justice Williams: If Ferranti's specification is limited to mercury bath meters, you are out.

Mr. Cripps: Well, it is of the essence of the argument I have addressed to your Lordship that the proper construction is not limited in either of those directions. He understood the question the learned Lord Justice was putting to him, was whether the words were so framed in the plaintiff's specification as to exclude energy meters. His argument was that it included them in the most direct terms and phrases. His submission was that in motor meters the plaintiff included all meters operated by means of lamp current to be measured or taken. He suggested that the first claim and the body of the specification corresponded. The whole point of claim 1 showed that there was no such limitation as alleged in the body of the specification. His case was that Claim 1 was exactly in accordance with the argument he had addressed to the Court. In conclusion, the learned counsel asked their Lordships to say that the judgment of Mr. Justice Swinfen Eady on both grounds was not right, and that judgment should be entered for the plaintiff.

Mr. Astbury said he did not know whether their Lordships would like him to address them at this stage of the case.

Lord Justice V. Williams: If we are not likely to hear Mr. Cripps again, I think you had better reserve yourself to a later stage of the case.

Mr. Astbury said he did not wish to travel over the same ground as his learned friend Mr. Cripps. There were one or two alternative points which he wished to make.

Lord Justice V. Williams: If you wish to make any other points, I think you must do that now, so that Mr. Moulton may know what case he has to answer.

Mr. Astbury: We raised these alternative points in the Court below, my Lord.

In the result Mr. Astbury went on to the bench and explained (in the presence of Mr. Bousfield) to their Lordships the different diagrams put in evidence. Having done this, the hearing of the case was adjourned till Saturday.

On resuming on Saturday morning, Mr. Astbury said that there were one or two points which he wished to put before their Lordships, and which had not, he thought, been dealt with by his learned friend, Mr. Cripps. The first matter which he asked their Lordships to take into consideration before they troubled about the specification, was as to what was the exact problem Mr. Ferranti had tried to solve. The second was how did he solve it? It was an extremely simple matter. The problem was this. Mr. Ferranti in 1883 had a meter which was the only practical meter of the motor type then in use. The problem which Mr. Ferranti had before him was this. When he used his meter, or wanted to use his meter for an alternating current, he could not make use of the residual magnetism which he discovered assisted the meter to start when he was using a solid magnet with a continuous current. When there was only a single lamp on, the difficulty was to start the meter. If you could once start it, a single lamp would keep it going. Mr. Ferranti appreciated that it was this little residual magnetism which assisted to strengthen the torque produced by one lamp and make the thing start. The problem he wanted to solve was how to help the thing to begin with a light load. He solved it by adding an additional coil, and nothing else. Mr. Ferranti's invention was simply putting on an additional coil coupled on the two mains. It was nothing else. The learned Counsel then addressed their Lordships on the question as to the construction of the plaintiff's specification, contending that Mr. Ferranti had not limited his invention to mercury bath meters, but had made it applicable to all motor meters. The real problem the plaintiff had to solve was to make the meter start, because static friction made it impossible if there was a light load for the thing to start, and starting was just as necessary in an energy meter as in a current meter. How could he possibly limit this invention to current meters as distinguished from energy meters? The distinction between the two had no more relevancy to the question they were discussing than any other possible distinction. It might just as well be said that there was a difference because the colour of the paint varied. Mr. Justice Swinfen Eady seemed to have based his decision on the words "current to be measured," but he omitted to notice that Prof. Ewing was absolutely in accord with the plaintiff. Prof. Ewing said that "current" meant lamp current, and it was perfectly idle to say that lamp current did not run through an energy meter in precisely the same way as a current meter. The only distinction between the two meters was, that in the current meter the lamp current was used to drive both parts of the meter. It would be a contradiction in terms to call the defendants' an energy meter. The defendants' meter shown without the plaintiff's starting coil might be called an energy meter, but with the coil it ill became them to say that theirs was an

energy meter, because where they took the coil they destroyed their machine as an energy meter.

Lord Justice Williams: You commenced by saying what the problem was which was to obtain assistance in starting. Well, you don't say that that is the subject matter of your invention, or what is claimed; or that you rest your case upon your machine being the concrete embodiment of the principle to obtain assistance in starting?

Mr. Astbury: No.

Lord Justice Williams: Well, you say get assistance in starting by an additional coil communicating between main and main.

Mr. Astbury: Yes; that is the whole thing.

Lord Justice Williams: But you say that every meter which is built upon the principle of getting communication between the two mains, and thus assisting the starting, is an infringement.

Mr. Astbury: Yes, if it has a coil between the mains.

Lord Justice Williams: But you must limit it a little more. You do limit it in words by saying "every meter which gets this communication by means of a force not outside the lamp current."

Mr. Astbury: But Mr. Justice Swinfen Eady has given no effect whatever to the words "applicable to other motor meters." He has limited the invention to one meter only, and that a mercury meter, for which there is no justification whatever.

Mr. Moulton then opened the respondents' case. He said that his learned friends were putting before the Court what might have been, perhaps, the case of the inventor if he had been wise, as one was wise after the event. He thought he should be able to show to their Lordships that what they were putting forward as being the invention, and as being claimed by the plaintiff, was a patent which, as he thought of all others, was one which he was anxious not to be thought to claim. Again and again the plaintiff had guarded himself from being thought to state his invention in the broad terms that had been put forward by Mr. Cripps and Mr. Astbury. He did not think Mr. Ferranti was wrong in so doing, but whether he was wise or not in this case, he was trying to claim that which he did not know would be useful, which in his (Mr. Moulton's) opinion was not in Mr. Ferranti's mind at the time, and he was now attempting to include in a patent that which neither on the facts nor on the merits, ought to be therein. Was this invention applied to motor meters. By motor meters he understood a meter of that type in which the current passing into it produced the motion in the way it did, and not an electric motor. The learned counsel then proceeded to deal with various earlier forms of motor meter, and passing to what he said was the real invention of the plaintiff, said that what he had done was to put in a coil which should give a permanent element to the stationary part of the meter without moving the rotary part. The hearing was again adjourned.

Mr. Moulton continued his address on Monday, on behalf of the respondents, and after reading plaintiff's complete specification, submitted that the plaintiff, both by negative and positive words, had described most accurately what he wanted, viz., that you must not do one thing and must do another. He (counsel) should like to put to their Lordships this one question, as to whether it was not a clear statement by the plaintiff that in his meter going through the mercury bath was not in accordance with his invention? He could not imagine a doubt upon that subject. He did not think it was possible to have a doubt that the plaintiff meant that, in that meter, sending it through the mercury bath was not in accordance with the plaintiff's invention. If their Lordships came to that conclusion, one felt oneself in the position of the triumphant chess-player who said "Mate in two moves." Could their Lordships possibly say that sending it through the mercury bath was not rigidly excluded? Everybody admitted that that was what was done by the defendants, and he (counsel) said it made it absolutely different from the plaintiff's. Defendants did something which the plaintiff's specification excluded. You could not have the safety of restriction and then forget the restriction when you came to infringement. You could not say "I pass it through, avoiding the meter circuit altogether," and then turn round and say "I wish I had not said that, because a man has not avoided the meter circuit," and allege that it was infringement. He thought it was perfectly clear that Mr. Ferranti had not got energy meters in his mind. His opinion was to energise one permanently and leave the other unenergised. The defendants never had the plaintiff's difficulty. The difficulty the defendants had was this. Their starting coil, as it was called, was a coil far more needed in running than in starting. Supposing one lamp represented the smallest current the defendants had got to deal with, defendants did not put this on because one lamp would not start the meter. He did not suppose that defendants' coil was one-tenth of a lamp. Defendants put it on for this reason: there was no rotating body which did not suffer friction. Now friction took off so much torque that the consequence was that friction always made one of defendants' registering meters register too little. If they could make it frictionless, it would be perfect. Now, what did the defendants do? They put an independent motor, which helped it to go, not in starting, but always. Now plus one-thousandth was the effect of friction. It had that effect whenever the thing was running. All the time it was taking one-thousandth off. If they could put anything which added on the one-thousandth, then they got an absolutely frictionless thing, which would register correctly. The effect of this motor was not one-tenth of the smallest current. It was for accurate registering that the defendants added this. Of course, it helped starting, because, in compensating for friction, it compensated whether the thing stood or whether it was going. But it was not added to meet the plaintiff's difficulty. His difficulty was never experienced by the defendants. The defendants were as well equipped for starting before they put their additional coil on as they were after. If their Lordships saw the plaintiff's description of his invention, and how it was to be put on, it was clear that it was not to interfere with the mercury bath—that was to be kept sacred, and then it would do what the helpful old residual magnetism did. He (counsel) wanted their Lordships to understand that the difficulty the defendants were dealing with was one which lasted through the running. The pickle the plaintiff was in was one the defendants had never got to face, namely, the small element acting upon another small element. The evidence showed that the plaintiff's invention was not applicable to all motor meters. It was not, for instance, applicable to the Chamberlain and Hookham motor meter. He submitted that the plaintiff excluded the case where the current went through the mercury bath, and that his directions were such as to exclude it. He contended that when the plaintiff's directions were looked at the first thing you saw described was the branch current going direct from main to main. He said that that meant that it went direct from main to main as a branch current, doing nothing else. He further said that if the claim were looked at it would be found that it was to be done "for the purposes hereinbefore described," and if you looked at the purposes hereinbefore described you found it was to fit the object previously attained by the residual magnetism, which was to have one energised element at starting. You also found that the limitation was to a class of meters where the motion was obtained, which meant wholly obtained from the current to be measured. All these things excluded a case like the defendants where the additional coil did not go direct from main to main, but did go through the part corresponding with the mercury bath and did not apply to a class of meters where the motion was obtained by the interaction of a constant thing with the current which was sought to be supplied. Therefore, in substance what the plaintiff wanted to get was not got by the defendants, and what the defendants did get was a thing which they got quite independently of the plaintiff's method of connection, because the defendants got over the plaintiff's difficulty before they began to deal with their further connection, and their connection was of a different class to the plaintiff's. On all these grounds he asked their Lordships for judgment for the defendants.

Mr. Bousfield then followed on the same side.

On Wednesday Mr. Bousfield concluded his arguments, and Mr. Cripps replied on the whole case.

Their Lordships reserved judgment.

Barratt v. New Imperial Electric Co.

In this case before Mr. Justice Bigham, in the King's Bench Division, on Tuesday, Mr. Macnaghten, on behalf of the plaintiff, moved for judgment on the ground that there had been a default in the delivery of defence. Counsel asked for an account for unliquidated damages and for an injunction, the account of damages to be assessed by the Master in Chambers.

Mr. Justice Bigham gave judgment as prayed, the account to be taken by the Master.

BUSINESS NOTES.

Annual Dinner.—The annual dinner of the Drake and Gorham Cricket Club was held on November 12th at the Holborn Restaurant. The chair was taken by Mr. Bernard Drake, Mr. Gorham and Mr. M. G. Drake being also present. After the usual toasts, the honorary secretary and treasurer, Mr. H. Beanham, reported that 24 matches had been played, 6 of which had been won, 9 lost, and 9 abandoned owing to the very wet season. The club was in a satisfactory financial condition, and a very good ground had been secured for next season. The Chairman in responding to the toast of "Success to Drake & Gorham, Ltd.," referred to the necessity of healthy recreation so as to secure good work, and said that the company was in a thoroughly sound condition, and busier at the present time than for some years.

Düsseldorf Exhibition. — The E.A.G. vorm. W. Lahmeyer & Co., Frankfurt-main, who were the largest exhibitors of electrical plant, having about 15,000 H.P. running at this Exhibition, have received the highest awards for their various machines exhibited in almost every group of the Düsseldorf Exhibition, viz., the large Gold State Medal and the Gold Exhibition Medal.

Art Fittings, Limited.—A company bearing this name has just opened an imposing range of showrooms at 112, Victoria Street, S.W. Instead of following the usual plan of crowding together every variety and style of fitting, they have furnished different rooms in certain distinct styles, the fittings being varied accordingly. One room has an early English character, another Flemish, another French, and so on. In addition to the electric light fittings many other productions in art metal work are shown, particularly in a metal which has the character of pewter without its drawbacks, being a pewter into the composition of which aluminium is introduced.

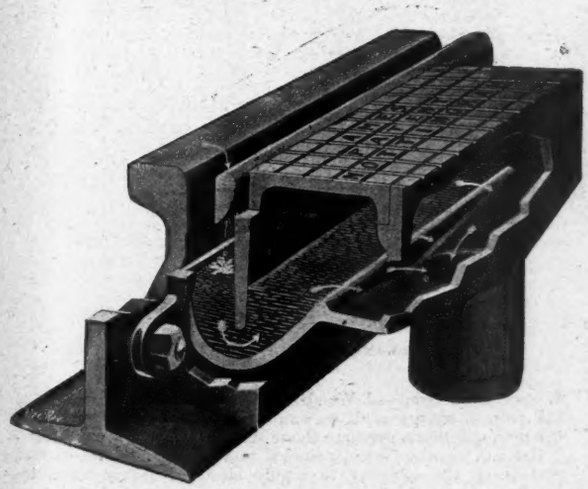
Electrical Wares Exported.

Week ending Nov. 19th, 1901.		Week ending Nov. 18th, 1902.	
Amsterdam	Value £178	Adelaide	Value £219
Auckland	24	Amsterdam	60
Azores. Teleg. mat.	150,100	Antwerp	60
Boca	42	Auckland	77
Bombay	756	Bangkok	80
,, Teleg. apparatus	42	Beira	490
Buenos Ayres. Teleg. cable	888	Bombay	179
Calcutta	1,348	Bremen. Teleg. mat.	48
Cape Town	982	Calcutta	899
Copenhagen. Teleg. wire	175	Cape Town	43
Durban	949	,, Teleg. wire	145
East London. Teleg. mat.	351	Chinde	10
Fremantle	25	Christchurch	86
Hamburg	49	Colombo	165
Hong Kong	265	Copenhagen	33
Melbourne	20	,, Teleg. wire	75
,, Tramway cable	561	Durban	402
Monte Video	93	,, Teleg. cable	175
Montreal	125	,, Elec. cable	1,375
New York	85	East London	34
Ostend	16	Fiji	56
Rangoon	11	Fremantle	720
Shanghai	502	,, Teleg. mat.	69
Sydney	360	Gothenburg. Teleg. wire	82
Wellington	55	Hamburg. Teleg. mat.	100
		Hamilton	165
		Hobart	20
		Hong Kong	95
		Lyttleton	105
		Madras	77
		Marseilles	55
		Melbourne	281
		New York	47
		Paris	21
		Perth	1,840
		Port Elizabeth	532
		Reval	328
		Rotterdam. Teleg. wire	83
		Shanghai	47
		Singapore	44
		Sydney	796
		,, Teleg. cable	152
		Tokio	44
Total £157,452		Total £10,262	

Foreign Goods Transhipped.

Flushing.	Elec. appar.	Value £175

New Tram-Rail Drain Box.—We illustrate herewith a patent trapped drain box for tramway rails which is being supplied by the Ames-Crosta Sanitary Engineering Co., Ltd., of Nottingham. As will be seen it is to afford a free escape of surface water from the rail to the sewer, the sewer gas being, however, perfectly water trapped. The cover can be easily removed so as to allow of obtaining free access to both trap and drain. The box is made to suit any section of rail, and can be applied to any existing tramline.



New Tram-Rail Drain Box.

The need for a well-drained track is well-known to all who have anything to do with permanent way work, and the figure so amply explains the idea of the Ames self-cleansing box for accomplishing this that no further description is necessary, except perhaps to add that the box is attached to the web of the rail by means of bolts as shown. We briefly described the Ames-Crosta patent stoneware conduits for electric cables in our issue of October 24th. The company has now brought out a new show list showing the application of the Standford joint where this system of conduits is adopted.

International Fire Exhibition.—Owing to the funeral of Prince Edward of Saxe-Weimar, H.R.H. the Duke of Cambridge was prevented from presiding at the meeting convened by the British Fire Prevention Committee in connection with next year's International Fire Exhibition, and the meeting was postponed. The meeting will take place at the same hour, 12 noon, on Wednesday next, the 26th inst., at the Royal United Service Institution, Whitehall, and the Duke of Cambridge has notified his intention of presiding.

Trade Announcements.—The New Taite Howard Pneumatic Tool Co., Ltd., and the International Pneumatic Tool Co., Ltd., have recently been amalgamated under the title of the Consolidated Pneumatic Tool Co., Ltd., and Mr. E. C. Amos, of 20, Bucklersbury, E.C., has been appointed sole London agent.

The partnership between Mr. Henry Adams and Mr. Hal Williams has been dissolved, and the firm of Adams & Williams has ceased to exist. Mr. Williams has moved into more convenient offices at the same address (60, Queen Victoria Street, E.C.), where, in pursuance of an arrangement with his late partner, he will carry on the electrical and refrigerating work which the firm had in hand at the time of the dissolution, and for which he has always been solely responsible. Mr. Williams will also continue his consulting practice in refrigeration, the design of factories, and the economical production of power, electrical and otherwise, and has opened a branch office in Manchester.

Messrs. W. C. Yuille & Co., of Glasgow, have been appointed agents for Scotland for Mr. A. P. Lundberg, of the Pioneer Electrical Works, Liverpool Road, London.

Messrs. Singer, Brown & Co, of Wyndham Street, Bridgend, have opened a department for business as electrical engineers and contractors, under the superintendence of Mr. W. H. Evans, of Liverpool.

Three-Phase Installation.—We understand that Tasker's Engineering Co., of Sheffield, have secured the contract for a complete three-phase power installation for Messrs. Charles Cammell & Co., Ltd. The alternators will be of the British Westinghouse Electric and Manufacturing Co.'s make, coupled direct to Belliss & Morcom engines.

Manchester and District Electrical Contractors' Association.—A general meeting of this association was held on Thursday, November 13th, at which 10 members were present. Three new members were elected, and the secretary presented a report of the work done by the Committee since the last meeting. The system of workmen's cards for providing respectable men with a travelling character was explained, and the cards distributed to members present, the arrangements for starting being now complete.

New Electrical Warehouses.—Recently we had the pleasure of inspecting the extensions to the warehouses of Messrs. Falk, Stadelmann & Co., Ltd., in Farringdon Road, E.C. These premises now comprise 10 large blocks in Farringdon Road and two of the streets behind. All the warehouses in each street are connected together by means of iron doors on each floor, which are closed at night, and are also serviceable for isolating in the case of fire. The blocks in the various streets are connected by means of iron bridges. A number of lifts throughout the buildings connect each of the floors, and some idea of the floor space may be gained when we state that it exceeds 2¾ acres, and over 500 persons are employed.

Messrs. Falk, Stadelmann & Co., Ltd., are essentially in the lighting trade; originally dealing with oil lamps and their various accessories; latterly with gas fittings and their various supplies; a a year or two ago with bells, telephones, and their component parts; and now with electric light fixtures, and all the other articles which go to complete an electrical installation. We have received a copy of their electrical fixtures catalogue, which is just issued. For a first catalogue it is fairly large, 120 pages, and covers a large range of fittings, mostly of popular lines, although the better class and style of fittings are not forgotten. A strong point is made of the fact that all the goods catalogued are stocked, and the electrical contractor will at once see the advantage of this. Samples of all the goods sold by Messrs. Falk, Stadelmann & Co., Ltd., are well exhibited in five spacious showrooms, recently remodelled and arranged, and these rooms are open to the trades interested in connection with "selection" orders. Copies of the catalogue will be sent to the trade on application.

Colliery Pumping Plant.—An electrical transmission of power plant has been made by Messrs. E. Scott & Mountain, Ltd., for the Ocean Coal Co., Ltd., for their Treharris Colliery, South Wales. A 300-H.P. horizontal long stroke compound engine is to drive a 170-KW. continuous current generator by means of ropes. One 170 effective H.P. electric motor will drive a set of the firm's special high lift three-throw ram pumps to deliver 250 gallons per minute against a 1,500 ft. head. The plant is now ready at Messrs. Scott and Mountain's works.

Schmidt Superheating.—We understand that Schmidt's Superheating Co., Ltd., have just received advices from Germany that the Prussian State Railway Administration has placed an order for 12 express, 12 passenger and goods, and 15 goods locomotives, all to work on the system in question.

Imports of Foreign Electrical Plant.—The value of the foreign electrical goods and apparatus imported into this country during last month is returned at £51,139, as compared with only £49,558 in September last, and £52,961 in October, 1901. So far as the year has gone, there has been a noticeable shrinkage in these imports, the returns for the 10 months ending with October last having reached a total of only £565,294, as contrasted with £736,781 in the corresponding period of last year, and £969,2:3 in the first 10 months of 1900.

Australia.—The import duty on electrical machinery and appliances in the Commonwealth of Australia, has been fixed at 12½ per cent. *ad valorem*.

Large Turbine Contracts.—Messrs. Escher, Wyss and Co., the hydraulic engineers of Zürich, Switzerland, have obtained the order, in competition with all the best makers in America and Canada, for three turbines of 10,000-B.H.P. each, making a total of 30,000-B.H.P., for the Niagara Power Co., on the Canadian side of the Falls. These turbines are the most powerful which have, as yet, been made. The 11 turbines of 5,500-B.H.P. each, for the American side of the Niagara Falls, were also supplied according to the designs of Messrs. Escher, Wyss & Co.

Mr. Alph. Steiger, M.I.C.E., of 28, Victoria Street, Westminster, S.W., who is the British representative for Messrs. Escher, Wyss, has also received from the Government of Mysore, India, an order for three turbines, for water works, to take the place of some of another make. He has also successfully started two turbines in the West of Ireland, and one in the West of England, and has several other plants in course of erection.

Book Received.—"Book of Standards and Useful Information pertaining to Tubular Goods." Edited by Prof. R. T. Stewart, Pittsburg, Pa.: The National Tube Co., 1902. $1.

Dissolutions and Liquidations.—The Electric Lamp Supply Co. is winding up voluntarily, with Mr. A. M. Day, of 33, Glasshouse Street, Piccadilly Circus, as liquidator.

The River Plate Electric Light and Traction Co. is also winding up voluntarily, with Mr. W. T. Western, 44, Charing Cross, W.C., as liquidator.

Messrs. A. H. Estall and H. E. Fiford (Fiford & Estall, electrical engineers, Settrington Road, Fulham, and St. John's Wood), have dissolved partnership.

Ediswan Fittings.—The Edison & Swan United Electric Light Co., Ltd., have a good showing of electric light fittings for the current lighting season on exhibition at their premises in Queen Street, E.C. We recently paid a visit to these showrooms where a variety of electroliers, pendants, hall lanterns, brackets, and so on are arranged for the inspection of the trade and their customers. Antique designs of hand-hammered fittings are much in demand, though the business in oxidised silver fittings still continues brisk. The Ediswan Co.'s own staff are responsible for the designs, and the fittings themselves are made by the company at Birmingham. Excellence of design and quality are now preferred to "cheapness" by purchasers. A new catalogue is in course of preparation, but pending the issue of this, a number of loose sheets of new fittings are being circulated among traders, for whom a small pocket list is also available. We show in the accompanying illustrations a few selected specimens. Fig. 1 is a 3-light polished brass ornamental electrolier; fig. 2 shows a dining room pendant finished in polished or antique brass, the 24-in. shade conceals three lights. Fig. 3 is a hall lantern with opalescent globe, which is held in position by means of the screwed rod support, and is easily removable; figs. 4 and 5 also show hall lanterns with satin finished and muffled glass respectively.

Fig. 4. Fig. 5.

Fig. 1. Fig. 2. Fig. 3.

Ediswan Fittings.

Catalogues and Lists.—An illustrated list of new pattern testing sets has been issued by Messrs. Nalder Bros. & Co.

November stock lists of c.c. dynamos and motors are being circulated by Messrs Royce, Ltd.

A pamphlet dealing with their gear wheels and pinions for electric tramcars, also describing the Falk rail joint, has come to hand from Messrs. R. W. Blackwell & Co., Ltd.

Messrs. Baxendale & Co., of Manchester, have sent us one of their October catalogues, containing descriptions with numerous illustrations, also prices of their electric light supplies, lamps for various purposes, holders, switches, cords, wires and cables, conduits and fittings, measuring instruments, dynamos and motors, &c.

Messrs. Tangyes, Ltd., of Birmingham, are circulating a list of new patterns of worm blocks at reduced prices.

List No. 134 of the B.T.H. Co. describes their type O K ampere-hour meter for continuous current circuits.

The General Electric Co.'s latest trade sheet shows their automatic ship's sidelight indicator and controller.

The Cambridge Scientific Instrument Co., Ltd., has brought out a pamphlet on the "Measurement of Temperature by Electrical Means," describing the electric thermometers of Profs. Callendar and Griffiths, which the company makes in two kinds, viz., resistance thermometers and thermo-electric thermometers. Both of these are detailed, and the many uses to which they may be advantageously put are mentioned, including chemical works, annealing furnaces, dust destructors, and electric power station steam plant. A list of prices of the instruments is followed with a description of Rosenhain's improved form of Thomson coal calorimeter.

Messrs. Nalder Bros. & Thompson, Ltd., of Queen Street, E.C., have sent us a copy of Section 3 of their new catalogue of electrical measuring instruments, &c. This particular section describes recording instruments (ammeters and voltmeters) for direct and alternating currents. It contains a number of excellent illustrations of the instruments, and diagrams of chart rulings. No. 4 section will be devoted to circuit-breakers.

ELECTRIC LIGHT AND POWER NOTES.

Auckland.—The R.D.C. has assented to an application by the Durham County E.P.D. Co. for a prov. order for the district.

Rexhill-on-Sea.—There was no opposition at the L.G.B. inquiry on November 11th into the Corporation's application for a loan of £16,000 for electric light purposes. The Town Clerk stated that there were now 285 consumers representing 15,033 8-C.P. lamps. This included public lighting. The electrical engineer (Mr. Le Feuvre), said that the first year's working resulted in a deficit of £199, the second showed a net profit of £402, and it was expected that the current year would show a profit.

Birmingham.—Included in the Bill which the Corporation is seeking to obtain in the 1903 Session of Parliament are provisions empowering the T.C. to make bye-laws for securing safety and the prevention of fire in premises supplied, or about to be supplied, with electricity; to empower the Corporation to supply energy in bulk to outside authorities, and to accept a transfer of an E.L. undertaking in an adjoining district.

Bognor.—Mr. Enright has accepted 200 guineas in discharge of his accounts for £373 16s. for fees in connection with the E.L. proposal of the U.D.C.

Brentwood.—The U.D.C.'s application for a prov. order is filed in the *London Gazette* for November 18th.

Bridgwater.—On November 12th the R.D.C. passed a resolution consenting to the Bridgwater and District Electric Supply and Traction Co. obtaining a prov. order for the construction of electricity works, and for the supply of electricity for public and private purposes, within the parishes of Bridgwater Without, Dunleigh, and Wembdon. The only stipulations are that the price of energy shall be uniform in the Rural and Urban districts, and that a purchase clause shall be inserted in the order.

The T.C. has also given its consent to a prov. order being granted authorising the company to supply electrical energy within the borough.

Burton.—The L.G.B. has given its sanction to a loan of £14,195 for additional generating plant and electric light mains.

Cambridge.—The Cambridge Electric Supply Co., Ltd., has informed the local authorities of its intention to apply for power to supply electricity in Chesterton, Cherryhinton, Coton, Fen Ditton, Girton, Grantchester, Great Shelford, Histon, Impington, and Trumpington.

Chatham.—The Kent Electric Power Syndicate (which has its chief office at Chatham) has become the purchaser of the Chatham undertaking of the Chatham and Rochester Electric Lighting Co., at the price of £62,791. The company has not done badly over this transaction, as some time ago the local authorities could have bought up the undertaking at a very much lower figure, something under £30,000. The purchase was carried out by arbitration.

Clacton.—The U.D.C. has decided to apply for sanction to borrow £15,225 for an electric lighting scheme.

Cowpen.—The offer of the Cowpen Coal Co. to light the rows at Isabella Pit and the A. Pit by electricity has been accepted by the D.C.

Dewsbury.—The Corporation electricity works, which have already cost nearly £40,000, are to be extended at an expenditure of about £10,000. The number of units supplied for the year ending March 31st, 1901, was 238,066, and at the end of March the number of consumers was 240, and the number of lamps connected equivalent to 18,000 8-c.p. lamps. The present extension is rendered necessary to meet the demands of the British Electric Traction Co., who have agreed to take energy from the Corporation for their electric cars. It is confidently anticipated that when the cars begin to run, the works will yield a substantial surplus.

Dingwall.—The T.C. has resolved to give Major Blunt power to supply electricity in Dingwall at 6d. per unit maximum price, with a discount of 20 per cent. to the Council; the terms to be revised every 10 years, and option to purchase at the end of 25 and 42 years to be given to the town.

Dover.—The T.C. is recommended to promote a Bill in Parliament for the purpose of obtaining powers to supply electricity to outside authorities, to accept a transfer of an E.L. undertaking in an adjoining district, and to raise money to purchase the undertaking of the Dover Electricity Supply Co., Ltd.

Edinburgh.—The system of distribution of electricity in Edinburgh is by a network of mains, of which there are at present something like 150 miles laid, and the mileage is constantly increasing. The electrical department under Mr. Newington, the resident engineer, has now mapped out the city into a number of districts—from 20 to 30 in all—and is arranging for fuses being placed in the distributing network at points midway between the feeding centres, so that in the event of a fault occurring the fuses round the faulty place will automatically disconnect this section, and the supply of the rest of the city will not be interfered with. There will be something like 70 of these fuses, which are to be placed in pillar boxes standing about 4 ft. above the edge of the pavement.

Elland.—The Greetland U.D.C. has applied to the U.D.C. of Elland as to the terms on which the latter will supply electricity for the purpose of lighting the district.

Falmouth.—The T.C. has approved an agreement with Messrs. Crompton & Co. with a view to the immediate introduction of the electric light into the borough. The company is to deposit £200; to pay all costs of the prov. order, whether it is granted or not; to provide a refuse destructor and dispose of all refuse; while the Corporation will receive £50 a year rent, and be at liberty to buy the works at the end of eight years.

Hornsey.—At the monthly meeting of the U.D.C. last week, members had before them the report of their engineer, Mr. E. J. Lovegrove, on their supplemental scheme for electric lighting. This report embodied figures which showed that capital commitments up-to-date exceeded the amount of the loan sanctioned by the L.G.B.—£73,500—by £8,462 1s. 3d., the total sum spent having been £81,962 1s. 3d. The amount of the loan for which it would be necessary to make application, was summarised thus:—

Excess of commitments over sanctioned amount to date	£8,462	0	0
Extension of mains (schedule "A")	4,463	0	0
" " (schedule "B")	1,675	0	0
Wiring and furniture	800	0	0
Engineering fees and contingencies	600	0	0
	£16,000	0	0

The efforts made by the Committee to obtain customers have resulted in 7,469 30-watt lamps being installed on premises already wired and connected with the mains.

Huddersfield.—The supply of electricity for lighting and power at Huddersfield shows substantial progress for the past year; 131 consumers have been connected, with 12,124 8-c.p. lamps, making the total number of consumers 1,653, with lamps equal to 110,617 8-c.p. It is stated that there are more lamps fixed in Huddersfield per head of the population than in any other town in Great Britain, excepting health resorts. The department had a gross profit last year of £10,851, and after paying interest and providing for the repayment of capital, the net balance of £2,561 was placed to the reserve. The following figures are of interest:—Average price obtained per unit, 3·80d.; capital expended, £154,357; total number of 8-c.p. lamps connected, 100,734; capital expended per lamp connected, £1·53. Owing to the large area of the borough and its scattered population, it would not be surprising to find the capital outlay much greater than in more densely populated towns.

The Mayor of Huddersfield for the ensuing year is Alderman F. Calvert, who has been chairman of the Electricity Committee since its formation, and much of the success of the department is due to his energy and ability.

Ingleton.—The Electric Light and Power Co., Ltd., is applying for Parliamentary powers not only to light Ingleton (Yorks) and neighbouring villages, but also to construct tramways. The company has contracted to supply the lighting of the town under its license, and now it seeks for further powers.

Keighley.—During October the Corporation sold 12,310 units of electricity, this being an increase of 6,647 units on the corresponding month of last year. From July 1st to October 31st, the sale amounted to 36,177 units, showing an increase of 24,177 units on the corresponding four months of 1901. Compared with the corresponding month last year the gas made by the Corporation during last October showed a decrease of 2,003,000 cub. ft., and the manufacture from July 1st to October 31st this year showed a decrease over the corresponding four months of 1901 of 1,925,000 cub. ft.

Kildare.—The L.G.B. has disapproved of the electric lighting scheme for Kildare. The scheme provided for an installation of Crossley's new patent engines. The L.G.B., however, vetoed it as experimental, in the absence of duplicate appliances, and on account of the cost, which would amount to 1s. in the £.

Knutsford.—The D.C. has decided to apply to the B. of T. for an extension of time in connection with the electric lighting order.

Lancashire.—The Lancashire Electric Power Co. has submitted to Whitworth U.D.C. a scheme for the supply of electricity to the district. It is proposed to take as the first line of route for the mains the following places:—Swinton, Radcliffe, Ramsbottom, through Rawtenstall, along the Rossendale Valley to Bacup, with a branch to Haslingden. Two return routes are proposed: one through Bacup, Whitworth, Milnrow, Crompton, Royton, Chadderton, Failsworth and Gorton, and the other *viâ* Tiverton, Westhouton, and Worsley. Provided the consent of the local authorities is secured, these routes will be adopted, and energy will be supplied in bulk at a cheap rate.

Limerick.—The contracts for the Corporation's electric lighting scheme were given to a local tenderer, Mr. Dillon, on the score that he was a Limerick man. It is now stated that the real contractors are a German company. As the tender in question was not the lowest, the situation is rather embarrassing for the Council.

Linthwaite.—The U.D.C. has agreed to the application of the Corporation of Huddersfield for a prov. order to supply electricity within the district.

Liverpool.—Mr. S. Higginbottom, M.P., has been appointed chairman of the Electric Power and Lighting Committee for the present municipal year.

Llantrisant.—The rural sanitary authority has notified its intention of applying to the B. of T. for powers for electric lighting purposes.

London.—Greenwich.—The Borough Council on Nov. 12th decided to inform the London County Council that it was in favour of an application being made to Parliament to have the Metropolitan Borough Councils empowered to wire and fit consumers' premises for electric light. Several members protested that this was going rather too far in municipal trading.

Luton.—The T.C. has received the sanction of the L.G.B. for the borrowing of £5,000 for electric light extensions.

Manchester.—A bad short took place in Great Jackson Street, Manchester, on Thursday last week. The heat generated was so intense as to crack the paving stones, and smoke escaped through the flags. The fire brigade was powerless to do anything more than prevent the heat from setting fire to the adjoining premises. Information was, however, sent to the electricity officials, and the particular section of the main was cut out. During the progress of the operations one of the firemen had a very narrow escape from being asphyxiated; he was in a cellar into which a good deal of the smoke and fumes from the fused main found their way. When he was called into the fresh air again he suddenly collapsed from the effect of the gases. Artificial respiration was employed, and after more than half an hour's work he regained consciousness.

Councillor Howarth was elected chairman in succession to Dr. Bishop, and Councillor Heaketh was re-elected deputy-chairman.

The resignation of Dr. Bishop as Chairman of the Electricity Committee has been accepted and his successor appointed. The matter has formed the subject of considerable discussion in the local press, and the Doctor's career has been described as "meteoric," &c.

Mexborough.—Owing to the existing plant at the electricity works being taxed to its utmost capacity, the U.D.C. has decided to apply to the L.G.B. for a further loan of £2,500 to meet the cost of extensions.

Monmouth.—The T.C. has resolved to undertake to wire the houses of new customers with Corporation labour, and on easy conditions.

Mysore.—The question of generating electric power for industrial purposes from the power obtainable from the water passing through the irrigation sluice of the Marikanave reservoir is still engaging the attention of Government.—*Indian Engineering.*

Newport (Mon.).—The total amounts expended by the Corporation on electrical undertakings up to the end of October, have just been returned as follows: On electric lighting, £101,707; tramways, £72,892; power station, £61,202.

Northampton.—The local Electric Light and Power Co. has decided to reduce the price of electricity for lighting purposes from 6¼d. and 3¼d. per unit to 6d. and 3d., at the New Year.

Penrith.—The U.D.C. on November 13th decided to adopt an electric lighting scheme, providing that a reasonable demand is forthcoming.

Plymouth.—The return of income and expenditure during the year 1901-2 shows receipts £13,323 and expenditure £8,487, leaving a gross profit of £4,835. The cost per unit sold last year was 2·19d. per unit, exclusive of capital charges. A member of the T.C., criticising these figures, pointed out that there was due to the bankers £45,352 on which no sinking fund had been paid. That expenditure had been spread over some years, and the

sinking fund would amount to £700 a year. Making allowance for this charge, and for another item of £250, he argued that instead of there being a net profit of £349 on the year's working there was really a deficit of over £600. Moreover, no provision had been made for depreciation or renewal. These statements were not refuted at the meeting of the Council.

Port Elizabeth (S.A.).—According to the *B. and S.A. Export Gazette*, the T.C. has obtained the consent of the ratepayers to set up an electric light installation at an expenditure of £100,000. The estimated cost of the installation is put at £60,000, the balance being intended for future extensions and modifications.

Prestwich.— The U.D.C. on November 13th approved of the recommendation of the E.L. and Tramways Committee that the Clerk should apply for a prov. order to amend the Prestwich E.L. Order, and to enable the Council to transfer it to Salford Corporation.

Rawdon. — The U.D.C. on November 12th received from Messrs. Le Maire & Parker, engineers, of Leeds, an intimation of their intention to apply for a prov. order to supply electricity in the district. It was decided to support the application, which also relates to the provision of electric tramways.

Ryde.—The E.L. Committee has reported that the I.W. Electric Light and Power Co. has submitted a site for the electricity works, which the committee cannot recommend for the approval of the Council.

Salford.—Mr. C. H. Wordingham, M.I.C.E., has been appointed by the Board of Trade to act as electric inspector under the Salford Electric Lighting Order.

Scunthorpe.—The U.D.C. is applying for a prov. order.

Sheffield.—The rapidly increasing demand for electricity for industrial purposes is shown by the numerous applications which the Corporation is receiving for the supply of energy for power purposes. Among the more recent are requests from the well-known firm of Chas. Cammell & Co. for 260 B.H.P. immediately, and from Messrs. W. Jessop & Sons, Ltd., for 250 B.H.P. at once, and a further 250 B.H.P. later.

Sidmouth.—The U.D.C. has decided to apply for a prov. order for electric lighting, and to advertise for tenders for leasing the order when obtained.

Spain.—La Compania Industria Electrica de Barcelona has secured a contract for the establishment and equipment of a central station for the electric lighting of the little towns of Brozas Garrovillas and Navas (province of Caceres). The station will comprise two 84-H.P. Crossley gas engines, using Dowson producer gas, and two three-phase alternators, developing 55 KW. each at a pressure of 5,000 volts.

Tiverton. — The borough engineer, Mr. J. Siddalls, recommends the T.C. that the E.L. installation it is proposed to establish in connection with the municipal gas works, should be worked by gas engines driven by "producer" gas, and that they should provide for a minimum of 2,000 8-C.P. lamps, which would probably have to be increased in 10 or 15 years, to a maximum of 6,000. He estimates the initial cost of the installation at £8,900, the annual working expenses at £1,100, and the annual receipts at £1,200. The T.C. has decided before coming to any decision to solicit offers from private firms for taking over the prov. order.

Weston-super-Mare.—The U.D.C. on Friday decided to ask the local electric light company to quote terms for the supply of electricity for the motive power at the new sewage works.

Weymouth.—At a meeting of ratepayers last week, a resolution was carried objecting to a municipal electricity supply being taken in hand; a poll will be held to settle the matter.

Glasgow. — The arrangements made by the tramway department for the supply of electricity from the Coplawhill sub-station to the lighting department are now complete, and in working order. The present demand is for about 800 KW., but it is expected that this will shortly be more than doubled.

ELECTRIC TRACTION NOTES.

Altrincham. — The local authorities of Altrincham, Bucklow (rural), and Ashton-on-Mersey, have decided to apply for a separate prov. order for the construction of so much of the intended Manchester to Altrincham tramway as will pass through their districts. Sale has already come to terms with the British Electric Traction Co. The Ashton-on-Mersey District Council, at its last meeting, expressed regret at the action of Sale, and resolved "that no scheme would be acceptable which did not provide through communication between Manchester and Altrincham." When the lines are constructed, however, through communication will be a mere matter of arrangement. The Manchester Corporation which, it is understood, will seek to control this traffic, has not, as yet, taken any public action.

Ashton-under-Lyne.—The T.C. has informed the Oldham, Ashton, and Hyde Electric Tramway Co., Ltd., that it is prepared to supply current to the extent of 850,000 units per year. This is an increase of 100,000 units, and is due to the extension of the tramways from Gee Cross to Bredbury.

Auckland (N.Z.).—The electric tramways system was expected to be ready for inauguration by about the middle of November.

Barton.—The syndicate which is proposing to construct an electric tramway from Barton-on-Irwell, near Eccles, to Cheadle, in Cheshire, *viâ* Flixton, Sale, and Northenden, has issued the requisite Parliamentary notices.

Bath.—The company was to commence work on the electric tramways on Monday, by laying lines from Cornwall Buildings to the Old Bridge, which is part of the route of the old horse tramways.

Beckenham.—The following additional particulars have been made known with regard to the proposed extension of the Beckenham tramways and the arrangement come to between the Beckenham U.D.C. and the B.E.T. Co. The tramway complete, including the track and electrical equipment, is to cost £20,000, the car shed £2,800, the power station £9,000, and cars £4,200, being a total of £36,000. The agreement sets out that the B.E.T. Co. will themselves provide and pay for the cars, costing £4,200, as well as the interest and sinking fund on the various works constituting the tramway, costing £22,800. On all expenditure exceeding this sum the company will pay increased interest and sinking fund on the basis of the agreement. The power station, costing £9,000, will be constructed at the cost of the U.D.C., who will recoup themselves with a margin of profit by selling current to the company as provided by the agreement.

Bournemouth.—A resolution has been formally passed by the Council confirming and adopting the terms of agreement for the purchase of the undertaking of the Poole and District Electric Traction Co., Ltd., as submitted to the Council in committee.

Buenos Ayres.—The *Financial News* says that Buenos Ayres is shortly to have an electrical omnibus service. That was said of London many years ago. And now?

Chatham.—A fourth death has resulted from the electric car accident which occurred on October 30th.

On Tuesday the inquest was resumed. Mr. Drakeford, traffic superintendent of the company, stated that strict regulations were laid down that no car was to descend Westcourt Hill without a pilot. One driver had been discharged for disobeying this regulation. Witness was frequently at the top of the hill, and he saw that the cars were accompanied by pilots. He had never had any fault to find with the driving of Pearce, the driver of the car, and he had never seen any difficulty in taking a car down the hill. Mr. Bate-Jones, the yard foreman in charge of the cars, said that on the day before the accident the driver called his attention to car 19 as having a flat wheel. The driver was given another car, and the car reported upon was tested by the traffic superintendent, the chief inspector, and witness on Chatham Hill. Witness drove the car, and found nothing wrong with the brakes whatever. When he returned to the station the flats were taken out of the wheel. One slight flat was left, but that was not detrimental to the running of the car. He also placed new cast-iron shoes on the hand-brake, and afterwards took a trial trip, and found everything in proper working order. The car did not go out again until the next morning. Mr. William Jensen, the company's resident engineer and manager, said the accident was partly caused by the greasy rails and partly because the car got away too quickly from the top. It was left to the pilot to decide whether the rails should be sanded. No drivers were appointed unless it was found that they were perfectly capable of doing the work after instructions. He was sure that the driver knew how to reverse the current. The inquiry was adjourned until 26th inst.

Coventry.—The T.C. has referred to committee proposals of the Coventry and District Electric Tramways Co. to extend the tramways to Earlsdon, a growing portion of the city, and through parts of the borough.

Dewsbury.—The trouble between the Dewsbury Corporation and the British Electric Traction Co. in regard to the curve at an awkward corner, which has caused the suspension of operations for many months, has now been satisfactorily arranged, and the work will be resumed at once.

Dudley.—On Saturday an electric car from Bilston, descending the somewhat steep gradient in High Street, jumped the points and crashed into the front of a big drapery warehouse. Three ladies who were leaving the shop at the moment had narrow escapes.

Edinburgh.—The Lord Provost's Committee of the T.C. will oppose the proposal of the Drake & Gorham Electric Power and Traction (Pioneer) Syndicate to introduce electric traction between the Corporation's tramways at Joppa terminus and Musselburgh, and also in regard to the proposed electric tramways to Queensferry.

France.—The tramways between Bayonne, Biarritz and Marrac are about to be converted into electrical lines, on the overhead conductor system. The power station will be located at Allées Paulmy, and will comprise three 400-H.P. engines and dynamos.

Bradford.—The Bradford authorities have done away with the unlimited crowding of the inside of cars, and have instructed their conductors to allow standing inside only in wet weather.

Germany.—The *Standard's* Berlin correspondent says that the Society for the Study of Rapid Electric Railways has concluded its experiments on the military line between Marienfeld and Zossen for this year. On the last day the electric locomotive had a whole passenger train, consisting of 11 coaches, and weighing altogether 154,000 kilogrammes, attached to it, in order to test its starting capacity. The result is said to have been most satisfactory. A further trial was made with the special express train cars of the two leading electrical companies in Berlin. Three of these cars, weighing altogether 98,870 kilogrammes, were attached to the electric locomotive, and a speed was attained of about 125 kilometres an hour.

Glasgow.—It is expected that the extension of the tramways from Shieldhall to Renfrew will be open for traffic on Saturday next. The line to Bishopbriggs is now nearing completion, and when it is finished nothing further will be done with extensions until the early spring, when the connection to Cambuslang and from Crookston to Paisley will be proceeded with.

Hastings.—Mr. W. M. Murphy intends to promote a Bill to enable him to construct electric tramways on the front line of Hastings and St. Leonards to Silverhill.

Hove.—At an adjourned special meeting of the T.C. on 17th inst. the tramways scheme was further adjourned for a fortnight, with a view to an arrangement being come to with the B.E.T. Co.

Huddersfield.—During the municipal year just closed, the operations in the Corporation tramways department have been extensive. Track equal to 13 miles of single line has been laid, including 1⅝ miles of single track to Honley, a township outside the borough. The whole of the permanent way is now electrically equipped, about 17½ miles having been converted during the year. The station plant has been considerably extended by the erection of an additional engine of 1,300 H.P. and generator of 650 KW. The boiler plant has been increased by a 650 H.P. boiler, and an additional economiser and superheater has been installed, whereby the horse-power at the station has been doubled. The tramways department has been re-organised throughout. All the steam rolling-stock has been dispensed with, with the exception of four of the best engines, which will be used for dealing with the snow in winter time. The number of units generated during the year amounted to 1,518,690, at an average generation cost of ·337d. per unit. The total traffic receipts amounted to £50,893 18s. 5d., an increase of £7,478 18s. 1d. upon last year. The number of passengers carried was 8,057,855. The average receipts per mile for the year were—steam 10·26d., electric 12·38d. Workmen's return tickets at cheap rates had been introduced. The financial position of the department showed a decided improvement during the 12 months, notwithstanding the fact that so many of the routes had been closed for reconstruction, and that there was a shortage of rolling stock. In spite of all these drawbacks, and the exceptionally bad summer, the balance sheet for the past six months shows a surplus of £166, or ·07d. per car-mile.

The tender of the British Electric Car Co. at £583 has been accepted for a motor-driven tower wagon for the carriage of coal. It was also decided to make an application to the Board of Trade for a prov. order for power to extend the tramways in five roads in the borough; and it was also agreed to double the line in New Street and Buxton Road in the main thoroughfares.

Isle of Man.—The registration of the new Manx Electric Railway Co., Ltd., was carried through last week. The capital of the company is £250,000, divided into 25,000 preference shares of £5 each, and 25,000 ordinary shares of £5 each. The preference shares will carry a cumulative dividend of 5½ per cent. on the amount paid up. The conveyance of the properties will be made direct to the new company.

Italy.—The Minister of Public Works has handed to the Superior Council of Italian Railways a plan for the transformation of the Giovian railways into electrically-worked lines. It has been decided to construct an electric railway through the valley of the Brembana, Italy. The Banca Mutua Popolare of Bergamo is interested. The construction of an electric railway from Verona to Riva di Trento has, at the instigation of the Chamber of Commerce of Verona and different local authorities, also been decided upon.

Keighley.—On the same day that notices were posted in connection with the Mid-Yorkshire Electric Tramways scheme, which embraces the length of road between Shipley and Keighley, the Keighley Corporation met and decided to take steps forthwith to obtain a prov. order to construct tramways from the centre of the town to the borough boundary at Stockbridge, a distance of about a mile.

Lancaster.—Trials of the new electric tramways have taken place this week. Owing to the power station not being ready, Mr. Tester, the engineer, has had to rely upon current from the electric light station to drive the trial cars. It will be Christmas before the cars are running regularly on the Scotforth and Park routes.

Leeds.—The Tramways Committee has decided that conductors shall allow eight extra passengers to stand inside when the weather is "inclement."

Leicester.—The Tramways Committee has resolved that the electric cars shall be double deckers and carry 52 passengers each. The Committee is experimenting with a number of "dry seats." There will be 23 miles of route and 43 miles of track, the majority of the routes having double tracks. In the case of double track, the Committee has decided on centre poles, and it offered prizes to the students at the Leicester School of Art for the best suggestions as to artistic poles combining strength as well, with the result that a design has been chosen, which several firms tendering for their supply characterised as the most beautiful they have seen.

Liverpool.—An important step towards completing the arrangements by which a goods service will be established on the tramways of South Lancashire, and between those tramways and the dock side at Liverpool, has just been taken. On Monday afternoon a deputation from the Tramways Committee of the Liverpool City Council, consisting of Alderman Chas. Petrie, the newly-elected chairman; Alderman F. Smith, deputy chairman; Councillor E. L. Lloyd, chairman of the Finance and Traffic Sub-committee; Mr. S. W. Higginbottom, C.C., M.P.; Mr. C. R. Bellamy, manager of the Liverpool tramways; and Mr. E. R. Pickmere, town clerk, waited upon the Traffic Committee of the Mersey Docks and Harbour Board, who control the Liverpool docks and quays. The deputation submitted a scheme for the carriage of goods over the Liverpool tramways, the aim being to establish through communication by tramways between the Liverpool docks and the manufacturing towns in the south of Lancashire. The Traffic Committee viewed the project favourably, and it was decided that further particulars of the requirements and proposed method of working should be obtained by both of the authorities, and that these should be considered with a complete scheme when ready.

At the first meeting of the Tramways Committee for the municipal year Alderman Charles Petrie was appointed as chairman of the Committee, and Alderman F. Smith as deputy chairman. Councillor E. L. Lloyd was re-appointed chairman of the Finance and Traffic Sub-Committee.

Maidstone.—There was considerable opposition on Tuesday at the inquiry held by the Light Railway Commissioners into the application of the T.C. for a prov. order authorising the construction of electric tramways in the town. In support of the application the Corporation presented petitions from townspeople and the residents of Barming, Wateringbury and Teston, the signatories from the three latter places praying for an extension of the tramway to those villages. The opposition came from some of the largest ratepayers, and the South-Eastern Railway Co.

Newcastle-on-Tyne.—At the meeting of the Tramways Committee on 13th inst. the city engineer presented a report on the lowering of certain roads, which would enable the largest double-deck cars to be run on all sections, whereas at present, on particular routes, only single-deck ones could be utilised. It was decided to lower the road at Elswick Colliery Bridge at a cost of about £3,000, and at Walker Road Bridge at a cost of about £1,500. Other two roads, viz., Welbeck Road and Victoria Street, also required lowering, but these are out of the city boundary, and it was decided to enter into negotiation with the authorities concerned. Tenders were received for the erection of a large new engine of 3,000 H.P. in the present power sheds to work the extensions of the tramways, and the tender of Messrs. Victor Coates and Co., of Belfast, was accepted for £13,200. The highest tender was said to be £23,784. The tender of Messrs. Russell & Co. for the supply of poles for overhead equipment for the extensions was accepted for £7,131, which was said to be 15 per cent. lower than the cost of the other poles in the city. In reply to a question, it was stated that the total expenditure on the trams up to date was £700,000, while the estimate was £614,000.

North-Eastern Railway.—Ten miles of the North-Eastern Railway Co.'s main line northward from York are to be fitted with electrically-controlled normal danger automatic block signals by the Hall Signal Co., of New York, U.S.A.

Nottingham.—Messrs. Ashwell & Tutin are applying for powers to construct electric tramways in the district.

Oldham.—A joint meeting has been held between the Tramways and Electricity Committees of the Oldham Corporation and the D.C.'s of Royton and Crompton upon the tramway question. The meeting was strictly private, but an opinion is prevalent that the Oldham Corporation will be asked to construct and work the tramways in these townships, which are in the Parliamentary borough, if suitable terms can be arranged.

On Friday last Major Druitt made a B. of T. inspection of the Featherstall Road section of the Corporation electrical tramways. There only remains the short length along Union Street West to be completed and inspected, and then the whole of the present scheme will be finished.

Preston.—The Tramways Committee of the Preston Corporation is considering the appointment of an electrical engineer for the borough. As soon as the position has been filled (which will be at the meeting of the Council in December), work upon the borough electric tramway system will be actively undertaken. The construction of the new generating station will first be proceeded with, and it is expected the electrical equipment will be complete when the time arrives for taking over the horse tramlines from the present lessees.

Railway Traction.—The Great Eastern Railway Co. is to seek powers this session to work its lines by electricity.

Redruth—Camborne.—The electric tram service was opened last Friday week. Cars conveyed a large number of guests to the generating station at Carn Brea, where an explanation of the works was given by Mr. J. C. Whigham, a director, who said he was looking forward to the time when electricity would be used as a means of power in the Cornish mines. Mrs. Beauchamp opened the station by turning on the lighting current to Camborne.

Ripon.—After interviewing the representatives of the Electric Power and Traction Co., the T.C. has decided to defer the question of providing electric tramways in the city until next spring, as the company has not had time to prepare particulars for applying for a prov. order this month. The scheme is generally approved of by the Council, and a plan of the route is being prepared.

Salford.—On Friday the Council adopted a number of proposals drawn up by the Tramways Committee for the electric tramways extensions. Salford will work the tramways in the Prestwich and Whitefield districts. The agreements with the two authorities were reviewed in the account of the proposals and improvements with regard to direct communication between the districts were selected. It was decided that there should be an application for compulsory powers for the purposes in view.

Sunderland.—At the meeting of the Tramways Committee on the 13th inst. Councillor Summerbell was elected chairman, and in returning thanks for his re-election made a comparison of the traffic in the past seven months of this year and the corresponding period of last year. This showed that from April 1st this year to October 31st the mileage covered was 756,424 as against 683,999 miles for the corresponding period of last year. The passengers carried were 8,784,193 as against 8,275,023 last year, an increase of 509,175. Then in the seven months referred to in 1901 the receipts were £34,481, and in 1902 £37,285, an increase of £2,803. This result he regarded as extremely satisfactory, especially having regard to the most unsatisfactory weather that had been experienced during the summer, at a time when the seaside traffic should have been very heavy. The general traffic had been, however, most regular. He thought that at the end of March, when the year ended, there would be a highly pleasing financial return. It was reported that the line to Fulwell was nearing completion.

Torquay.—A plebiscite has been taken on the tramways question, and as a large majority of votes were given in favour of negotiations being opened with a company, the municipal scheme has been dropped.

Willenhall.—The B.E.T. Co. has ceased for the present to run cars on the line between the Old Bank and the Board Schools on the Walsall Road. The reason is that the number of passengers who used the cars did not warrant the company in continuing to run them daily. The service may, however, be resumed when a through passage can be made to Darlaston, and meanwhile the cars will run on Saturdays only.

Yarmouth.—It has been ruled that two-thirds of the Council should have been present, and should have voted at the statutory meeting held last week to decide as to a £45,000 extension of the electric tramways. The proposal received 28 votes, and the minority wrecked the scheme by refusing to vote in the negative.

TELEGRAPH AND TELEPHONE NOTES.

American Pacific Cable.—A *Standard* dispatch from Washington says that the Attorney-General has summoned the officers of the Corporation who are planning the Pacific cable to a Conference. They have not accepted the stipulations for an American landing imposed by the President, but are actively proceeding, nevertheless, both towards laying the cable and entering into obligations which violate the President's conditions for an independent cable to Asia. They are proposing to connect with the British cable at Honolulu, thus lessening for it the risks arising from the unprecedented length of line between Fanning Island and Victoria.

Brighton Telephones.—The T.C. last week rejected, by 36 to 12 votes, a suggestion that the proposed municipal telephone service should be abandoned, and negotiations entered into with the National Telephone Co.

Italian Telephones.—The new trunk line between Rome and the principal cities of northern Italy has just been completed, and the trials are at present being carried on. The towns of Torino, Milan and Genoa are now connected directly with the Italian capital. The new line will be inaugurated towards the end of December or the beginning of January. Besides giving communication to the north of Italy, connections are now established with many important towns between Rome and the north. The line passes through Pisa where it is divided into three sections, one going to Genoa, a second to Torina, and the third to Milan.

Leicester Telephones.—The Telephone Committee has decided not to recommend the Council to establish a municipal telephone system.

Netherlands Government Cable.—The *Financial Times* says that two cable laying steamers, recently launched, and, now completing on the Tyne, are about to undertake an important international work. The two vessels are being built for the Eastern Extension Telegraph Co., which has contracted to lay and supply on behalf of the Netherlands Government a telegraph cable between the island of Borneo and the island of Celebes. The steamers now constructing are to be entrusted with the work of laying the cable.

The Piscicelli Postal System.—It is reported from Rome that Signor Galimberti has made definite measures for conducting experiments with the electric postal system in Italy simultaneously with those of Great Britain. The Transvaal is said to have invited Signor Piscicelli to proceed there personally and superintend the installation of an experimental plant.

Swansea Telephones.—The Corporation Telephones Committee last week further considered the telephone scheme in reference to the Tunbridge Wells decision, and it was agreed that Mr. Hopkins, who had acted as consulting engineer for the Corporation scheme, should be again called before a meeting of the whole Council for the purpose of answering any points which had been recently raised in connection with the Swansea scheme. The committee also appointed Mr. Mackie, of Guernsey, as manager of the undertaking.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Latakia-Cyprus	June 20, 1899	..
Communication with Carthagena and Barranquilla (Columbia)	Dec. 8, 1900	..
Trinidad-Demerara No. 1	Aug. 27, 1901	..
Trinidad-Demerara No. 2	Nov. 1, 1902	..
Dominica-Martinique	May 8, 1902	..
Dominica-Guadeloupe	Nov. 4, 1902	..
St. Lucia-Martinique	May 8, 1902	..
Guadeloupe-Martinique	May 9, 1902	..
Santa Cruz de Teneriffe to Tejita de Teneriffe	July 4, 1902	..
Puerto Plata-Martinique	July 10, 1902	..
Guantanamo-Mole St. Nicholas	Aug. 4, 1902	..
Cayenne-Pinheiro	Aug. 13, 1902	..
St. Lucia-St. Vincent	Sept. 19, 1902	..
Reissi-Issa	Oct. 22, 1902	..
Reissi-Yemani	Oct. 22, 1902	..
Marseilles-Barcelona	Nov. 8, 1902	..
Cadiz-Teneriffe	Nov. 3, 1902	..
Landlines :—		
Route *via* Hanekin on Persian territory	Feb. 24, 1900	..
Communication with Tientsin and Taku *via* Hetampo	July 18, 1900	..
Communication with Maranham	Sept. 19, 1902	..

Wireless Telegraphy.—The Under-Secretary of State for Posts and Telegraphs of France has appointed a commission for the purpose of studying the practical application of wireless telegraphy. The commission is constituted as follows:—President, M. Berard, Under-Secretary of State for Posts and Telegraphs; members, Messieurs Bordelongue, Cousin, Chapsal, Salomon, Sins, Estaunié, Larose; on behalf of the Ministry of Foreign Affairs, M. de Cazotte; for the Ministry of the Colonies, Messieurs Bouteville and Commandant Houdaille; for the Ministry of War, Colonel Poline, Commandant Boulanger and Captain Becq; for the Ministry of the Interior, M. Bruman; for the Ministry of Marine, the Captain of the *Adigard* and the Captain of the frigate *Favereau*; for the Ministry of Public Works, Messieurs Ribière and Blondel; secretaries, Messieurs Verlière and Poulaine. The first meeting of the commission took place on Monday, November 10th, at the Ministry of Posts and Telegraphs, 101, Rue de Grenelle, under the presidency of the Under-Secretary of State. Later, M. Trouillot, Minister of Commerce and M. Bérard, Under-Secretary of State for Posts and Telegraphs, accompanied by their Chefs de Cabinet, M. Chapsal and M. Salomon; and also by M. Bordelongue, director of the electrical department of the Ministry, and M. Delahet, lieutenant in the Navy, attached to the headquarters staff of the Ministry of Marine, paid a visit to the French Society for Wireless Telegraphy in the Place Madeleine, where they were received by the President of the Administrative Council. Prof. Branly furnished them with the most precise and detailed information upon wireless telegraphy and the new apparatus of which he is the inventor. After visiting the electric installations of the Society, the Ministers witnessed some experimental demonstrations with the Branly-Popp inventions, notably with the interchange of messages between receiving and transmitting stations. The experiments were highly successful, and M. Trouillot warmly congratulated Prof. Branly and his collaborators. The French budget proposals for 1903 include a sum of 2,073,365 fr. for the purpose of increasing and improving electric installations and lines with especial reference to the employment of multiple telegraph apparatus, the erection of new call offices, and the transformation of the aerial system into a subterannean system.

A 50,000-VOLT ELECTRIC TRANSMISSION SYSTEM.

Missouri River Power System.

One of the most important electric transmission systems of modern times is that of the Missouri River Power Co., which enjoys the distinction of being the system employing the highest electrical pressure of any in commercial use to-day. Like so many of the famous American electrical schemes, this has been put down to supply power principally for the mining industries in the neighbourhood of a stream from which the primary energy is drawn. The generating station is situated beside the Missouri River at a spot about 20 miles from the town of Helena, Montana, where, by throwing a dam across the river, a head of water of about 30 ft. has been obtained. The dam is 480 ft. in length, and it has been erected in such a position that a low-lying valley just above has been enclosed, and forms an excellent storage reservoir some seven miles long by two to three miles wide in extent. From this lake, the water reaches the power house *via* Black Rock Canyon, which is about half-a-mile long, and from 400 ft. to 700 ft. wide. The power house is built alongside the dam at the mouth of this natural waterway, in a small town known as Canyon Ferry. Although in the winter the water in the lake freezes, no trouble is occasioned by this, since the rushing stream in the canyon is never frost-bound. It is calculated that the available power of this hydraulic system will aggregate at least 10,000 h.p. all the year round. A good idea of the rugged nature of the district will be gathered from the illustrations, which show the country to be of the class one instinctively associates with the mining history and romance of the North-Western States; the history of the neighbourhood is, in fact, altogether connected with its various mines. The district first became known to the outside world as a spot rich in gold deposits. Since that time, gold mining has fallen almost entirely away, although there are still a few individual placer miners to be seen at work not more than one mile from the power house. The bulk of the power generated is transmitted to larger towns further distant, where the refining and smelting of copper ores forms practically the sole avocation of the residents, and calls for the major portion of the power of the Missouri River Company.

Fig. 1.—General View Showing Missouri Power House.

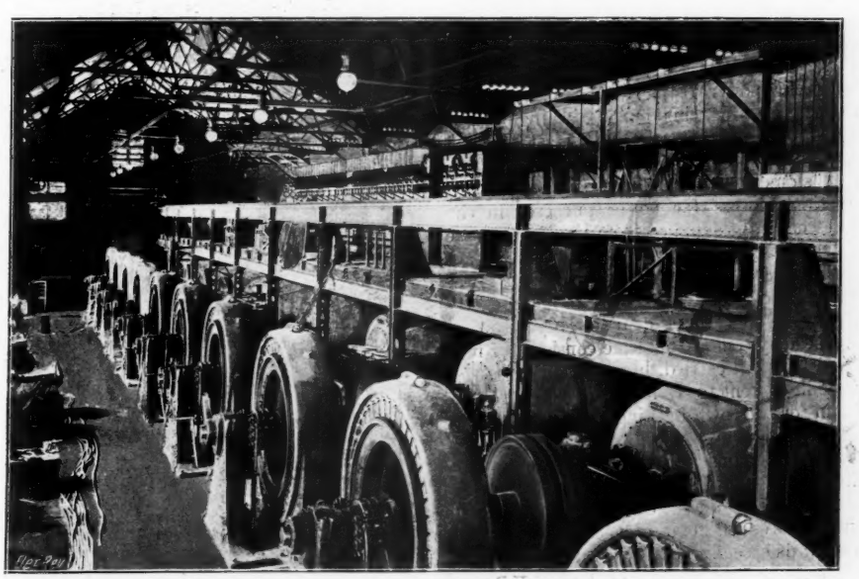


Fig. 2.—Interior of Power Station Showing Ten 750-kw. Westinghouse Alternators.

Although this power scheme has been spoken of as being recent, it is only in connection with the high pressure used that this term may be applied, for it is some ten years since the first steps were taken towards the putting down of an electric power scheme at Canyon Ferry, though it is only since March of this year that the high pressure of 50,000 volts has been used. The original scheme came into actual

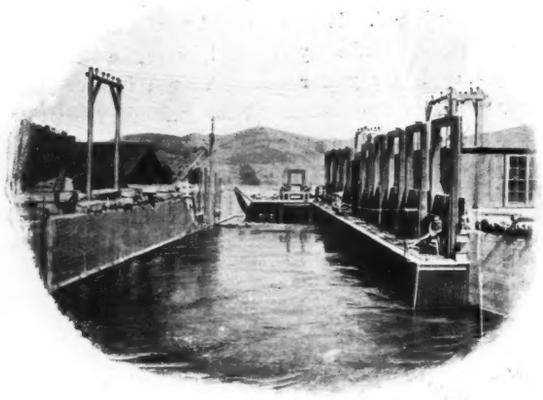


Fig. 3.—Forebay and Gates.

being about four years ago, and turbine-driven electric plant of 4,000 horse-power was put down. This plant consisted of four direct-driven two-phase Westinghouse alternators, each of 750 KW. capacity, driven through flexible couplings by independent water-wheels. Two other independent sets were 90 KW. Westinghouse exciters. The two-phase current was generated at a pressure of 550 volts, and passed direct from the machines into a bank of eight transformers of the Westinghouse oil-insulated type, by which the pressure was raised to 10,000 volts. At this high pressure the current was transmitted by overhead mains to sub-stations in the towns of Helena, 20 miles distant, and East Helena, 14 miles distant. In the former place, the current was reduced to a pressure of 2,200 volts, and was mainly used for the street arc lighting and general incandescent lighting of private houses. The lighting of the city was undertaken by direct-current series arc-lighting machines driven by alternate-current induction motors. The street tramways of the town also received their power from the alternate-current supply, the direct current for this purpose being drawn from a pair of rotary converters. At East Helena the current consumption was more of a private nature, and the main customer was a large smelting firm which used induction motors for power purposes in the works, and incandescent light supplied from the same source for lighting the works. In addition to the transmission lines going direct to these towns, there was a third, which was installed for the purpose of supplying power to a large ore-concentrating plant situated some distance beyond East Helena. The overhead system at that time consisted of four sets of transmission lines, all carried, however, on one set of poles; two of these lines went to Helena, there being independent circuits run for the town lighting and for tramway work.

As time went on, the demand for power for the rapidly growing ore-refining works of the neighbourhood necessitated a considerable increase in the capacity of the electric power system, and towards the end of the year 1900 work was commenced towards extending the generating station to accommodate plant having an output of 10,000 H.P., and also to extend the area of the supply. The additional generating plant put down consists of six 750-KW. Westinghouse alternators, each coupled direct to a 45-in. horizontal turbine. The current produced by these machines is in the form of three-phase at a pressure of 550 volts. The original four generators were of the two-phase type, but they have been overhauled and converted into three-phase machines, so as to make the whole of the main generators uniform in type and size. There are now, therefore, ten 750-KW. three-phase 550-volt alternators installed in the power station. The additional exciters put down consist of a direct-current machine yielding 225 KW. at a pressure of 150 volts and driven direct by a separate waterwheel, and a smaller machine of 115 KW. at a similar pressure but direct-driven by an induction motor. The original exciting plant is still in use, so that the entire direct-current machinery at present consists of two 90-KW. and one 225-KW. machines driven by separate turbines, and one of 115 KW. capacity driven by an alternate-current induction motor.

A view of the interior of the power house is given in fig. 2, which shows the 10 Westinghouse rotating-armature alternators with their driving turbines in one long row, and the switchboard gallery overhead. The gallery extends the full length of the building, and carries the whole of the switchboard arrangements and also 12 transformers. A general view of the main switchboard, which consists in all of 17 panels, is given in fig. 7. The panels are all of blue Vermont marble, fitted in accordance with standard Westinghouse practice. Ten of the panels—five at each end of the board—are set apart each for a main generator, four are feeder panels, and carry the instruments and switches used in connection with the 10,000-volt step-up transformers, two

Fig. 4.—Transmission Line.

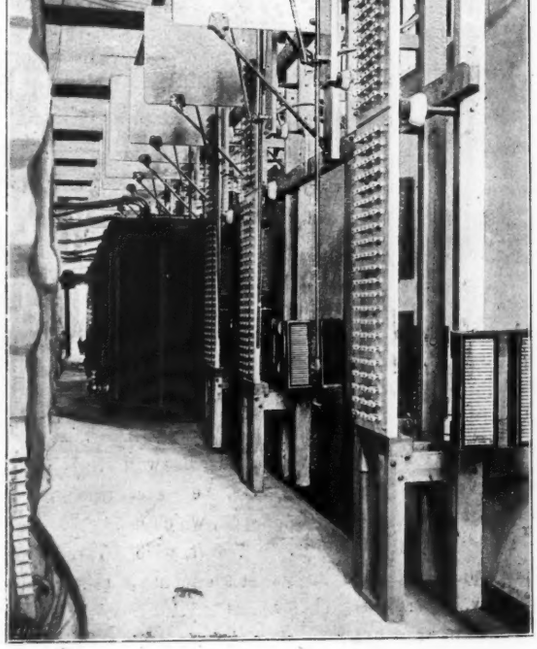


Fig. 5.—Main Switchboard. (Back View.)

others are similar panels for the 50,000-volt circuit feeders, and the seventeenth panel, in the middle of the board, is a junction panel bearing switches whereby the three sets of main bus-bars can be connected together as desired. The switchboard for the exciter circuits consists of four marble panels, one for each exciter, the circuits being arranged on a duplicate set of bus-bars. The regulating rheostats of the fields are installed under the floor of the gallery. The

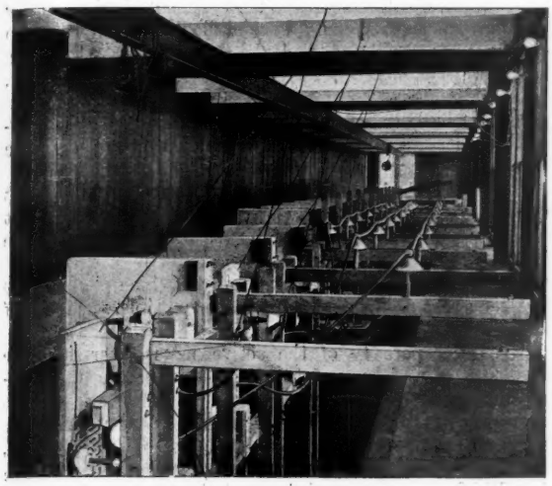


Fig. 6.—Showing Connection of 50,000-Volt Line to Switchboard.

multiple-contact switches of these are operated by vertical shafts rising through the floor, and terminating in handwheels on pedestals in front of the machine panels. A view of a portion of the back of the switchboard is given in fig. 5. A bank of Westinghouse oil-insulated transformers is shown, and the illustration also shows clearly the installation of lightning arresters.

The extra high-pressure circuit of 50,000 volts is only used on the new transmission line which has been put down between the power station and the town of Butte; the total length of the pole line to this town is 65 miles. Two lines of poles, about 50 ft. apart, have been installed, the transmission lines being in duplicate; the poles of each line are about 110 ft. apart. The cables in both cases are arranged in the form of an equilateral triangle, being spaced 6 ft. 6 in. apart, centre to centre. A general view showing a portion of the pole line is given in fig. 4. The cables themselves are of seven-strand copper, and the lines are transposed five times between the power station and Butte. Glass insulators are used of a special triple-petticoat type, supported on oak pins treated with paraffin. A long glass sleeve resting over the oak pin serves as an excellent means for keeping the wood dry. It has been found that the oak pin as used on this line, when thoroughly dry and treated with paraffin, is in itself an efficient insulator for the line, even at the high pressure of 50,000 volts. The method of connecting the switchboard with the overhead mains is shown in fig. 6. The wires pass direct from behind the switchboards up through glass tubes in the roof of the power house; these glass tubes are protected outside by hoods.

The transformers installed in connection with the 50,000-volt system are of the oil-insulated, water-cooled Westinghouse type, there being six of these installed at the power station each of 950-kw. capacity. Six of a similar capacity, but of the ratio of 50,000 to 2,200 volts, are installed in the sub-station at Butte. Two of these transformers, together with four static interrupters and high-pressure switches of the well-known long-break "stick" type, are shown in fig. 8, as installed in position. Another view of the interior of the Butte sub-station is fig. 9, in which the 2,200-volt distribution switchboard is shown. The whole of the electrical apparatus in connection with the power station and sub-station equipments is of Westinghouse manufacture, the plant used being of their standard well-known types.

It is expected that the demand for power in the town of Butte will in itself be sufficiently large to keep the whole of the power plant at Canyon Ferry fully loaded, so that success on this score is apparently assured. The 50,000-volt portion of the system has been in continuous use since March of this year, and we are informed that as yet, not the slightest mishap or failure has occurred to interrupt the supply. The whole of the work has been designed and carried out, and high as is the pressure of the transmission line, it would appear that the limit has not by any means been reached in that direction.

DETERIORATION OF STORAGE BATTERY PLATES.

Mr. M. U. Schoop writes to the *Electrical World and Engineer* with reference to an article by Prof. A. L. Marsh, and especially with reference to the statement that in a good lead storage battery (for traction purposes), the negative plates (spongy lead) last at least two or three times as long as the positive plates (peroxide of lead). Speaking of stationary batteries as made by most of the Continental manufacturers, it is doubtless true, he says, that the life of the negative plates is longer than that of the positive ones,

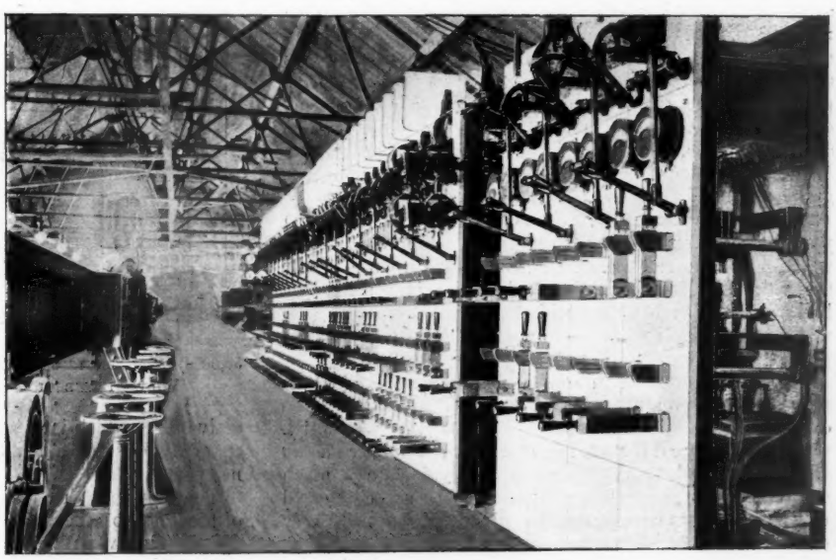
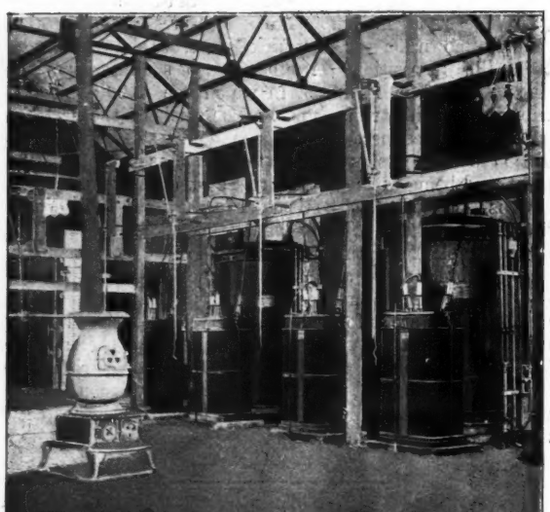


Fig. 7.—Switchboard. (Front View.)

simply because the ratio of the capacity of a new negative plate to a new thoroughly treated positive plate is as 2 : 1.

If the terminal pressure of a relatively new storage battery during its discharge is divided into its components, it will be found in the case of most of the modern storage batteries that the rapid fall of pressure of the storage battery is due to the exhaustion of the positive plate. In the course of time there will be, according to the excellence of the battery, a more or less evident variation of the capacity ratio, regardless of whether the positive plates are pasted or of the Planté

type. This variation means that the capacity of the negative plates becomes slowly less, beginning from the first day that the battery is operated and caused by the peculiar shrinking of the spongy lead, a fact which up to this time has never been thoroughly explained. Probably the capillary spaces



50,000-Volt Electric Transmission System: Fig. 8.—Interior of Sub-Station,—Westinghouse Transformers.

in the spongy lead are closed up by the lead which is being gradually thrown down by a galvanic process—which among storage battery experts is known as "leading."

After about two years the ratio between the positive and negative capacities is no longer as 1 : 2, but as 1 : 1·5. After two more years, the peroxidation of the lead grating has progressed so far, or the active mass has become so spongy, that a renewal of the positive plate is found necessary. By closely inspecting the negative plates the active mass shows small tears, the spongy lead is disintegrated, and the union between it and the lead support has become less secure. An accurate test of the capacity of the negative plates would show that the capacity is only about one-half of what it was at the beginning; and if new positive plates are now inserted, then the rapid fall of pressure is caused no longer by the giving out of the positive plates, but by the giving out of the negative ones.

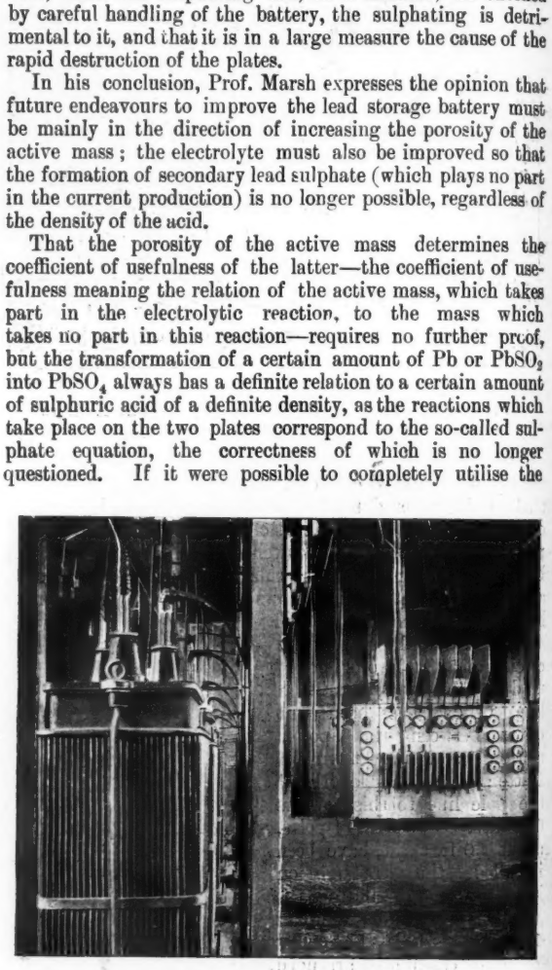
The above evidence Mr. Schoop has gathered during 10 years' practical experience with lighting and power batteries which had a normal use. In almost every case the life of the negative plates in stationary batteries is considerably longer than that of the positive plates, but the cases in which second positive plates are renewed while the negative plates remain in the battery are very scarce.

In the case of traction storage batteries, of which the article in question mainly treats, and in which a large capacity with a minimum of weight and space is essential, the conditions are different, in so far that the builder has no longer an interest in giving the negative plate a much greater capacity than the positive one; the space reserved for the electrolyte is very small, and for that reason a very concentrated solution must be used. Another point which must be taken into consideration is the frequent rise in temperature of the acid during the operation of the battery, which causes the sulphating of the negative plates.* In the case of storage battery cars in which the cells are placed close to one another, and where there is generally no ventilation at all, Mr. Schoop has often noted at the end of the charge temperatures of from 50° to 60° C.

The local action of the sulphuric acid on the spongy lead is least when the density of the acid is from 1·150 to 1·170 (at 15° C.). This density is the one used by most manufacturers of stationary batteries. For traction purposes, however, the electrolyte must be much stronger, on account of lack of room, and when the battery is charged, the density is generally from 1·250 to 1·300. In this case the action of the acid on the lead is three times as great as when the density is 1·150. This, in the writer's opinion, is a very important point to which too little attention is being paid by manufacturers. It is certain that in nearly all traction batteries the life of the negative and positive plates differs but little, and the problem to construct the faultless spongy lead plate for traction purposes is certainly as difficult of solution as to construct a peroxide of lead plate which has a long life. The statement by Prof. Marsh, however, is perfectly correct, that, while the sulphating can, in a measure, be checked by careful handling of the battery, the sulphating is detrimental to it, and that it is in a large measure the cause of the rapid destruction of the plates.

In his conclusion, Prof. Marsh expresses the opinion that future endeavours to improve the lead storage battery must be mainly in the direction of increasing the porosity of the active mass; the electrolyte must also be improved so that the formation of secondary lead sulphate (which plays no part in the current production) is no longer possible, regardless of the density of the acid.

That the porosity of the active mass determines the coefficient of usefulness of the latter—the coefficient of usefulness meaning the relation of the active mass, which takes part in the electrolytic reaction, to the mass which takes no part in this reaction—requires no further proof, but the transformation of a certain amount of Pb or $PbSO_2$ into $PbSO_4$ always has a definite relation to a certain amount of sulphuric acid of a definite density, as the reactions which take place on the two plates correspond to the so-called sulphate equation, the correctness of which is no longer questioned. If it were possible to completely utilise the



50,000-Volt Electric Transmission System: Fig. 9.—2,200-Volt Distribution Switchboard in Sub-Station.

active mass which is present instead of only about $\frac{1}{3}$, then three times the amount of sulphuric acid would be necessary.

The prospects, therefore, of improving the life and capacity of the plates of the modern lead storage batteries may be designated as very slight.

Scottish Electric Lighting Acts.—Last week in the House of Commons, the Lord-Advocate asked leave to introduce a Bill to amend the borrowing provisions of the Electric Lighting Act, 1882, and the Electric Lighting (Scotland) Act, 1890. The Bill is to get over a difficulty under the Electric Lighting Act which presses very hardly on the town of Dundee in regard to electric lighting. Under the Electric Lighting Acts it is provided that the borrowing powers there given shall be created under the same conditions and provisions as the borrowing powers for gas, and much against his will, he had had to give a legal ruling that had the effect that, if a certain amount of money had been already borrowed for gas, that must be taken into account in seeking borrowing powers for electric lighting. This is a complete bar against electric lighting going on.

* See *Zeitschrift für Elekt.*, Vienna, 1901, on "The Effect of Temperature Rise of the Acid on the Capacity of Lead Storage Batteries," by M. U. Schoop.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—November 26th. Electrically-driven tower wagon for overhead tramway repairs. See "Official Notices" November 7th.

Barking Town.—December 1st. Steel and iron car shed. See "Official Notices" November 14th.

Blackburn.—November 24th. Boilers, stokers, superheaters, economisers, feed pumps, pipes, condensers, ash and coal conveying plant. See "Official Notices" November 7th.

Bristol.—December 11th. Water-tube boilers and accessories. See "Official Notices" to-day.

Buluwayo.—February 26th, 1903. Establishment and working of an electric tramway. See "Official Notices" to-day.

Clacton.—December 22nd. Two economic boilers, piping; two 100-KW. steam dynamos, balancer and boosters; switchboard; cables, &c.; accumulators; crane. See "Official Notices" November 14th.

Dublin.—December 8th. The D.U.T. Co. wants tenders for general stores, including electrical supplies, for a year. See "Official Notices" to-day.

Durban.—December 5th. (1) Complete telephone exchange equipment, 7,200 lines; (2) Underground dry-core air-space cables for the Corporation. See "Official Notices" November 7th.

Erith.—November 26th. Wiring and supply of fittings at Council offices. See "Official Notices" to-day.

Finchley.—November 24th. Boilers, balancing sets, crane, batteries, mains, street lighting, &c. See "Official Notices" November 7th.

France.—January 1st. The Prefectural authorities of the department of Calvados are inviting projects until January 1st, 1903, for the construction and working of an electric tramway, for the transport of passengers and goods between Trouville and Honfleur, a distance of about 10 miles. Particulars may be obtained from, and proposals are to be sent to, La Prefecture de Calvados, Caen.

Harrogate.—December 6th. 4-KW. d.c. dynamo complete and switchboard. See "Official Notices" to-day.

Italy.—November 25th. The Adriatic Railway authorities in Florence are inviting tenders until the 25th inst. for the supply of three electric locomotives.

Lowestoft.—November 26th. Overhead equipment and poles; cables, &c, for tramways. See "Official Notices" Oct. 31st.

Malta.—November 28th. The local authority at Valetta wants offers for the concession of electric tramways connecting Valetta and Cospicua, Senglea and Vettoriosa and the Casal Zebbug. Particulars from Mr. Wm. Casolani, Receiver-General and Director of Contracts, Valetta, Malta.

Manchester.—November 26th. Power and distributing circuits, arc and incandescent lighting at Stuart Street station and ten sub-stations. See "Official Notices" November 14th.

Manchester.—December 3rd. 600 electricity meters. See "Official Notices" to-day.

Pontypridd.—November 22nd. Tramways permanent way, traveller and storage battery. See "Official Notices" Oct. 31st.

Spain.—November 28th. The municipal authorities of Chinchilla are inviting tenders until the 28th inst. for the concession for the public and private electric lighting of the town during a period of 15 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Chinchilla, Spain.

Stalybridge. — November 24th. Motor-generators, switches, starting motors and transformers, booster sets, balancers, air compressors, accumulators and travelling cranes for the Stalybridge, &c., Tramways and Electricity Board. See "Official Notices" November 7th.

Sunderland.—November 28th. Steam dynamo, three-phase motor-generators and transformers, and switchboards. See "Official Notices" October 17th.

Swansea.—December 1st. Electric motors and starting switches (12 months' supply) for the Corporation. See "Official Notices" November 14th.

CLOSED.

Ashton-under-Lyne. — The T.C. has accepted the tender of the St. George's Ironwork Co., of Hulme, for the supply of a 12-ft. turntable at the tramway station.

Birkenhead. — The Corporation has arranged with Veritys, Ltd., of Manchester, for a year's supply of their English-made Aston-Lundell motors.

Bloemfontein.—Messrs. Crompton & Co., Ltd., have secured the contract for two 200-KW. 3-phase alternators coupled to Belliss engines, and 100 incandescent fittings and pillars for street lighting, from the Bloemfontein Corporation, through Messrs. Davies & Soper.

London.—The L.C.C. has accepted the tender of the Edison & Swan Co. for the supply of certain engineers' goods and electrical stores during 1903.

Mersey Railway.—Messrs. Rowland Carr & Co. have secured the contract from the British Westinghouse Co. for the supply of the steel cable ducts required by them in connection with their Mersey railway contract.

Newcastle-on-Tyne.—Messrs. V. Coates & Co. are to supply the new 3,000-H.P. engine for the tramways station at £13,200. Messrs. Russell & Co. are to supply tramway extensions poles at £7,131. See our "Traction Notes" to-day.

Sheffield.—The British Schuckert Electric Co., Ltd., has received an order for 50 electricity meters from the Corporation.

Stalybridge.—The following tenders have been accepted by the Stalybridge, Hyde, Mossley and Dukinfield Electricity Board:—Messrs. Tinker, Shenton & Co., Ltd., Hyde, for six Lancashire boilers for the generating station; Hiram Maxim Electrical and Engineering Co., Ltd., for surface condenser and pumps, piping, &c.; Messrs. Higginbottom & Mannock, Ltd., for a 30-ton electric travelling crane; the Stanton Ironworks Co., Ltd., for pipes; Messrs. Marple & Gillott, Ltd., of Sheffield, for 243 30-ft. lengths of tramway rails.

FORTHCOMING EVENTS.

Friday, November 21st.—At 8 p.m. Institution of Junior Engineers. Inaugural meeting of the Session at the Westminster Palace Hotel. Col. Edward Raban, C.B., will deliver his Presidential Address on "The Preparation of Engineering Projects."

At 7.30 p.m.—North-East Coast Institution of Engineers and Shipbuilders. Meeting at the Lecture Theatre of the Literary and Philosophical Society, Newcastle.

Wednesday, November 26th.—At 2 p.m. Institution of Civil Engineers (Students' Visit). To inspect the conversion operations in progress on the South London Tramways.

Thursday, November 27th.—At 2.15 p.m. Institution of Electrical Engineers (Students' Section). Visit to the works of Messrs. Siemens Bros. & Co., Woolwich.

At 8.0 p.m. Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers. Paper on "Electrons," by Prof. Sir Oliver Lodge.

Friday, December 5th.—Northampton Institute. Prize distribution by Lord Chancellor and annual conversazione.

Monday, December 8th.—At 8 p.m. Society of Arts. Cantor Lecture I., by Prof. Vivian B. Lewes, on "The Future of Coal-Gas and Allied Illuminants."

Wednesday, December 17th.—Institution of Electrical Engineers. Annual dinner in the Grand Hall of the Hotel Cecil.

NOTES.

Mr. Garcke and his Octopus.—The first annual convention of the British Electric Traction Associated Cos. was held at Loughborough on Tuesday. Mr. E. Garcke, managing director, presided over a conference on the subject of traffic organisation. Lord Vaux of Harrowden, chairman of the Brush Electrical Engineering Co. subsequently occupied the chair at a luncheon to which the convention was entertained by that company, whose works are at Loughborough. The toast of "The British Electric Traction Associated Cos." was proposed by Lord Vaux, and responded to by Mr. E. Garcke, said his lordship had referred to the word "octopus" as applied to their companies. It had been dinned into his ears a good many times during the past few weeks. He used the word himself some six or seven years ago, when they were going over the prospective schemes which they were determined to carry out. For it was their policy and determination to go into every corner of the United Kingdom and do work which

until they came was neglected. And so long as there was work of that character to be done he took it they were going to do it regardless of what they were called. He had been very much inclined to treat all these attacks with the contempt they deserved; in fact, he had acted on that inclination. It had been asked why he did not reply to the attacks. It was true he had made no reply until now, but, as he was among his colleagues and managers, and might not have another opportunity of saying what he wished, he would say that the reason why they did not intend to make any reply was simply that whenever a man made a reckless and deliberate misrepresentation, that man had no desire to be corrected, and they knew that if any reply was made, no matter what its nature, that reply would be perverted. The attacks had been mainly political, and therefore they could treat them as such—they knew how such attacks arose, and might be expected. They were, as he had said, doing a certain amount of work which had been neglected, and now others regretted that they had not done the work themselves.

Glasgow Technical College Scientific Society.—A meeting of this society was held on Saturday evening, when a paper was read by Mr. George Wilkinson, borough electrical engineer, of Harrogate, on "The Diesel Engine." The lecturer said in his opening remarks that the Diesel engine may now be considered well out of the experimental stages, having proved itself thoroughly reliable in operation. Within the last few months, however, several important constructional modifications had been made, and these had, to a considerable extent, improved the engine in mechanical efficiency and reduced its cost. The lecturer then gave a description of the Diesel cycle, and put forward some interesting results of trials recently made by himself on a engine built for the Corporation of Harrogate. Prof. W. H. Watkinson opened a discussion which followed, and referred to several difficulties which had appeared in the early stages of the development of the engine and to the success recently obtained. Several other engineers took part in the discussion, at the close of which a hearty vote of thanks was awarded to Mr. Wilkinson for his paper.

State-Owned Cables.—The Governments of Holland, France, and Germany have lately been actively engaged in promotion of the laying of cables, paid for by the State, with a view of connecting up some of their possessions in the East Indies and elsewhere, in such a way as to avoid the necessity of passing over lines owned by British companies. These cables may be divided into three groups:—(1) France—Tamatave to Reunion, 460 miles; Reunion to Mauritius, 150 miles; Brest to Dakar, 2,415 miles. (2) France and Holland, in conjunction, have agreed as to the laying of a cable between Saigon (Cochin China) and Pulo-Condor, 140 miles; and Pulo-Condor to Pontianak (Dutch Borneo), 660 miles. (3) In conjunction with Holland, Germany has arranged to lay cables from Balikpapan (Borneo) to Menado (Celebes), touching at Kwandang, a length of about 390 miles. This cable is to be provided by the Netherlands Government; but the line is to be further continued by the joint Governments from Menado to the Pelew Islands, from Pelew Islands to Yap, and from Yap to Guam, or to some other point near, or in connection with, the American Pacific cable which is now in the course of being laid, a total length of about 1,680 miles, the Governments jointly paying a subsidy of £70,000 per annum for the laying of these last cables.

As regards the French groups, tenders were received during the course of last month, these being limited, however, only to French subjects with works in France, the result was that neither of the cables in this group were tendered for at sufficiently low prices to be acceptable to the Government, and it has been hinted that this was due to some understanding between the French companies tendering. There is, however, reason to believe that the Brest—Dakar cable will shortly be laid without tenders being again asked for. As regards the cables from Cochin China to Dutch Borneo, negotiations have been going on between the Netherland and French Governments since March, 1900, which came to a standstill as the French Government wished the Government of the Netherlands to bear the whole cost of such a cable; but in consequence of an agreement between the Governments, arrived at about the end of last year, the laying of the cable was decided on and has been adjudicated to Messrs. Grammont, a French company, for a sum of £198,420, or, say, £250 per mile. It is expected that this cable will be laid very shortly. It is intended that from Saigon this line, by connecting with the existing French line which runs to Amoy, might afford a means of reaching the lines belonging to the Great Northern Telegraph Co., and thus establish a communication over the Siberian landlines with France, avoiding the British cables. As regards the cables which runs from Borneo to Celebes, this is already, we understand, in course of manufacture by the Telegraph Construction and Maintenance Co., and will shortly leave England on the two new repairing steamers which are being completed for the Eastern Extension Telegraph Co. Part of the scheme is, of course, to connect Java, *viâ* Borneo, Celebes, &c., with the American Pacific cable, which will thus provide a route to Germany across the United States to New York, where it will meet the German Atlantic cables. A branch line of this system is also proposed by laying a cable from the Pelew Islands to Shanghai, a length of about 1,800 miles; thus Germany, in the case of a recrudescence of the troubles in China, will be able to telegraph to Berlin independently of either the British cables or the landlines running through Russia and Asia.

It is worth while paying considerable attention to the movements of our possible rivals in the East—all the more so as many people in authority in the English Government look at the question of State ownership of cables more as furnishing grounds for a pious opinion than as a matter of real and urgent importance

The Post Office Telegraph Corps.—The *Times* says that at the Parcel Post Office, Mount Pleasant, on Tuesday, Lady Murray distributed medals to 150 members of the Post Office Corps and the Royal Engineers Telegraph Reserve, who have recently returned from South Africa. Lieutenant-Colonel the Hon. F. L. L. Colborne, commanding the 24th Middlesex (Post Office) R.V.C., in the name of the regiment welcomed the men home, and expressed satisfaction with the way in which they had done their duty in the field. He said that there went out to South Africa nine officers and 585 men of the Post Office Corps, and 453 men of the Royal Engineers Telegraph Reserve, or a total of 1,047. He regretted to say that there were 45 deaths, and that 119 men had to be invalided home. They had one officer and 60 men still in South Africa. Several officers and men were mentioned in despatches, three officers got the C.M.G., and two of the Engineers obtained the Distinguished Service Medal.

Auction Sale.—The sale of plant of the Charing Cross and Strand Electricity Supply Corporation, referred to in our last issue, will take place on December 4th. See our advertisement pages.

Motor Cabs Too Costly.—A Berlin Press correspondent says that the motor cabs which have been plying for hire in the streets of German towns for the last three years, were on Tuesday finally withdrawn, it having been shown that they entail a great loss to their proprietors.

Municipal Trading.—In the House of Commons on Monday Mr. Balfour, in reply to a question, said that he regretted that the Select Committee on Municipal Trading was not reappointed, but he hoped that there would be an opportunity of reappointing it at no distant date.

The Rapid Transit Turbines.—Messrs. Brown, Boveri and Cie., of Baden, write to us as follows, the letter arriving too late for insertion in our "Correspondence" columns:—"We notice the following passage in an article published in your No. 1,303 issue on the Westinghouse steam turbine for the rapid transit subway:—'The most striking constructive feature is the separation of low pressure and high pressure cylinders, and the introduction between them of a reheater. . . . .' It may be interesting for your readers to hear, in connection with the said striking constructive feature, that the separation of high pressure and low pressure cylinders in Parsons steam turbines was adopted by Mr. Parsons himself for the Elberfeld machines, which have now been running for several years. As regards the introduction between the high pressure and low pressure cylinders of a reheater, as adopted by the Westinghouse Co., we may rightly, so far as we know, claim to have been the first to propose such an arrangement for turbines, which we did as far back as the beginning of 1900 when tendering for the large Frankfort steam turbine. The said arrangement is specially mentioned in the Frankfort contract. We hope that you will publish the above for the information of your readers, as the article above referred to might lead people to believe that the Westinghouse Co. are proposing something quite new and unheard of."

Personal.—On Friday last, at the National Telephone offices in Whimple Street, Plymouth, Mr. D. J. Barnes, the local manager of the National Telephone Co., Ltd., was the recipient of a handsome silver combination epergne and flower stand, on his leaving for Birmingham.

Mr. Sam. Trail Jamieson, from Rosslyn Terrace, Kelvinside, Glasgow, has recently been promoted to the position of chief electrician of the West India and Panama Telegraph Co.'s c.s. *Newington*.

Mr. John Fairlie, A.G.T.C., B.Sc., who has been assisting Prof. Jamieson with his system of teaching electrical and mechanical engineering by correspondence, was recently appointed asa telegraph superintendent to the Indian Government from amongst 80 applicants. He sailed for Calcutta the other day.

We understand that Mr. A. A. King, who was for the past eight years "chief representative" for Messrs. Veritys, Ltd., has now joined the staff of the General Electric Co., Ltd., of Manchester and London.

Stalybridge, Hyde, Mossley and Dukinfield Electricity Board has appointed Mr. J. D. Mosley and Mr. John Farrell to superintend the laying of the conduits for electric cables, and Mr. Harry Booth, Mr. Robert Clarke, and Mr. J. W. Pollard as inspectors to superintend the construction of the permanent way of the electric tramways.

Metallic Packing.—Before the Yorkshire College Engineering Society, at Leeds, on November 11th, Mr. A. McSwiney, of the United States Metallic Packing Co., Bradford, read a paper on this subject, in which he separated engine packing into three classes:—Fibrous materials, such as asbestos, hemp, &c.; a combination of these materials and metals, and purely metal packing. The fact that 5,000 patents had been taken out for mechanical packing evidenced the interest and importance of the subject. Seven conditions that a perfect packing should fulfil were laid down, viz:—Small contact, constant pressure, steam setting, automatic working, capability of retaining vacuum, lateral motion, and durability. The good points and drawbacks of various forms of simple and mixed packings were illustrated by slides and models, special mention being made of a "duplex" packing suitable for high-pressure and superheated steam.

Train Signalling by Electricity.—The directors of the North-Eastern Railway Co. in August last obtained the provisional sanction of the Board of Trade for the installation on the main line of the N.E.R., near York, of electric automatic signals, and have, we now learn, recently placed a contract with the "Hall" Signal Co., of Broadway, New York, for the fixing of the electro-automatic track circuit signalling system. There will be 84 signal arms. All the posts will have two arms, applicable to the next stop signal. Each of the sections will be 1,200 yards in length. A novel feature of the installation will be the means used for operating the signals. Until quite recently under the "Hall" system the semaphore signal was worked by an electric motor, but now carbonic acid gas has been adopted as the motive power, and it is this form of signal that is to be used on the North-Eastern line. The gas is contained in a cylinder at a pressure of 600 lbs. per square inch (reduced to 50 lbs. working pressure), whilst the valves for admitting the air to the operating cylinder are controlled electrically. This class of signal has now got beyond the experimental stage, as there are several thousands in operation in the United States, and it is found that a fully-charged cylinder contains sufficient power for operating a signal more than ten thousand times, whilst the cost of maintenance is considerably reduced. For the electric automatic signalling it is claimed that it presents the "block" system in perfection by supplanting human intelligence with exact mechanism, whilst in addition to reducing the "wages" bill by the abolition of "intermediate" boxes, it increases the "carrying" capacity of a railway by enabling the sections to be shortened without the expense of erecting and "manning" signal boxes.

London Telephones.—In the House of Commons the other day Sir T. Dewar asked the Postmaster-General whether he was yet in a position to say when the extension of the Post Office telephone system throughout the Metropolis and suburbs would be complete; would he state the amount expended by the Post Office up to the present time on this service, the number of subscribers, and the amount of their rentals? Mr. A. Chamberlain, in reply, said that seven Post Office telephone exchanges had already been opened in London since March 1st last. These served districts included more than half the previous users of telephones. Four other exchanges to serve large areas were well advanced. Owing to the rapidly increasing demands for a telephone service it was not practicable to name a date for the completion of the system. The authorised expenditure on works now in progress was, roundly speaking, £1,262,000. These works provided not only for services to the existing subscribers, but to a much greater extent for future requirements. The number of subscribers' telephones now worked was 5,150, and this number was being increased at the rate of from 150 to 200 a week. The receipts in respect of the local exchange services in London up to the end of this month was £34,473.

Tender Deposits.—Mr. W. Devonport, the secretary of the National Electrical Manufacturers' Association, Blackfriars, S.E., has written to Mr. Frank Schofield, Clerk to the Board, Town Hall, Stalybridge, in the following terms:—"The attention of this Association has been drawn to your advertisement (Contract No. 7) in the technical Press, and I have been requested to bring to your notice the fact that one of the terms is altogether unusual and quite contrary to the spirit of such contracts in general. The condition in question is that which declares that the five-guinea desposit will be returned to those whose tenders 'are in order, but not accepted.' The words 'are in order' introduce an entirely new condition in tendering, and as this might lead to much subsequent misunderstanding as to the return of the deposits paid for the specification, I have been requested to ask you to be so good as to draw the attention of your committee to these words, with the view of having them deleted."

The Student's Suggestion.—The following letter comes to hand just as we go to press from Prof. S. P. Thompson, of the Finsbury Technical College:—"If the 'Evening Student' had addressed his letter to 23, Leonard Street, instead of 4, Ludgate Hill, I could have informed him what has been done, is being done, and will be done, to obviate the inconveniences which inevitably arise when an abnormally large number of students seek instruction in a laboratory with limited space and equipment.—Silvanus Thompson."

Appointments Vacant.— Assistant mains superintendent (£2) for Aberdeen; junior engineer at Crewe at £80; an assistant electrical inspector for L.C.C. at £175; station superintendent for Ilford at £150; mains superintendent at Wimbledon at £120; an assistant electrical engineer at Newport (£150), and a meter inspector. See "Official Notices" to-day.

The Silvertown Co.—The India-rubber, Gutta-percha and Telegraph Works Co. is promoting a Bill with the following sections:—"Extension of powers of company; repeal or amendment of the company's Act of 1884; alteration of memorandum of association; extending operations beyond the United Kingdom; holding of shares, stock or securities of other companies, and stock and securities of public bodies."

The Patent Law Amendment Bill.—This measure was read a second time in the House of Lords on Monday.

London County Council.—The Council at the meeting on Tuesday decided to grant a loan of £17,950 to the Stepney Borough Council for electric lighting and meters. The Highways Committee reported that there was little or no probability of the Council obtaining, within the time specified by the Standing Order of Parliament, the consent of the road authorities to the construction of the proposed tramways from (1) Edgware Road to Harrow Road; (2) Shepherd's Bush Road to a point near the Marble Arch (3) New Cross Road *vid* Lewisham High Road to Loampit Hill and Vale to the South-East Metropolitan Tramways; and (4) Tooting Broadway *vid* Mitcham Road to Tooting Junction railway station. At the suggestion of the Committee, the Council decided not to proceed any further with these schemes in the next session, although it is hoped to revive them on a future occasion.

Awards.—The Royal Society has awarded the Rumford Medal to the Hon. C. A. Parsons for his success in the application of the steam turbine to industrial purposes, &c.; a Royal Medal to Prof. H. Lamb for his investigations in mathematical physics; and the Hughes Medal to Prof. J. J. Thomson for his contributions to electrical science, especially in reference to the phenomena of electric discharge in gases; also the Davy Medal to Prof. S. A. Arrhenius for the application of the theory of dissociation to the explanation of chemical change.

Wolverhampton Exhibition.—The guarantors have been considering whether to continue the Exhibition next year, in the hope of recovering some of the loss which has been incurred this year. The expenditure for the last six months has been £93,000, the income £58,000, and the deficit £34,000. The proposal was rejected.

THE CENTRAL STATION ENGINEER.

A very pleasant evening was spent at the Croydon Electricity Works, on Wednesday evening last week, when "as a sequel to the recent fire and breakdown at the works," Alderman D. B. Miller, chairman of the Electricity Committee of the Croydon Corporation, entertained the staff to dinner. Alderman Miller was supported by the Mayor and Mayoress (Sir Frederick and Lady Edridge), the Misses Miller, Alderman Goodwin, Ex-Councillor Hinton (the vice-chairman of the Committee, who lost his seat at the late election) and Mr. J. Gray Scott (chief engineer). Alderman Miller said he was prompted to hold that dinner by a desire to show in a practical way his appreciation of the services of the staff in connection with the late fire. Owing to the excellent work performed by them, the machinery was got into working order, and the supply resumed in a marvellously short space of time. Mr. Scott replied on behalf of the staff and himself.

Mr. A. P. M'Donall, assistant engineer to the Notting Hill Electric Lighting Co., was recently presented with a Queen Anne tea and coffee service from the directors, chief engineer and secretary, a case of carvers from the office staff, a tantalus from the staff and employés, and a silver matchbox from the meter department, on the occasion of his marriage with Miss Frances Ethel Reeves, of Wellington, N.Z.

Mr. Norman E. G. Little, late of the Bolton Corporation Electrical Works, has been appointed chief assistant engineer at the Doncaster Corporation Works, in succession to Mr. Jones, who has been appointed chief engineer at Batley.

Mr. Gilbert R. Spurr, assistant electrical engineer to the Ilford Urban District Council, has been appointed tramway manager. Mr. J. E. Allen, mains superintendent at Wimbledon, has been appointed outside superintendent at Ilford.

On the recommendation of the Light Railways and Electric Lighting Committee, the Southend-on-Sea T.C., on the 12th inst., resolved that Mr. W. E. J. Heenan, at present temporary electrical engineer, be appointed borough electrical engineer, with a salary of £350 per annum; Mr. Heenan to devote the whole of his time to the duties of the office, not to be allowed private practice, and to reside within the borough. Mr. Heenan will have complete charge of the electricity generating station, plant and electrical equipment in connection with the light railways and electric lighting undertakings, and will perform the other duties of borough electrical engineer. Mr. Heenan was appointed temporary engineer in December last, and prepared the specifications for the electric lighting plant; a continuous supply was commenced in October last, and there are now 150 consumers with about 10,000 equivalent 8-c.p. lamps connected. Mr. Heenan has also had to reconstruct part of the overhead equipment of the light railways system.

Mr. Robert Sim, at present in the employment of the Electric Lighting Department of the Edinburgh Corporation, has been appointed assistant electrical engineer under the Falkirk Corporation. There were between 50 and 60 applicants for the position.

Mr. F. J. Robinson has resigned his position of resident engineer and manager for the Salsburn Electricity Works, in order to take up a position with the British Westinghouse Co. in their Newcastle branch. Mr. F. R. Batty has been appointed consulting engineer and manager in his place, but will still retain his position as resident engineer and manager for the Northallerton Electric Light and Power Co.

CITY NOTES.

Eastern Extension, Australasian and China Telegraph Co.

The fifty-eighth half-yearly general meeting of the shareholders of this company was held on Wednesday at River Plate House, Sir John Wolfe-Barry, K.C.B., presiding.

The Chairman, in proposing the adoption of the report, said that the gross revenue for the half-year had amounted to £283,000 against £346,000 for the corresponding period of 1901, showing a decrease of £62,000. He was sorry to have to report a decrease, but he was bound to say that it was due to causes entirely beyond the control of the directors, and was very greatly due to the great depression of trade in the Australian Colonies. The whole of the £62,000 was not due to a decrease of traffic, because in the corresponding period there was a contribution to the revenue of £23,000 from exceptional causes, such as profits on contract work and matters of that kind. Consequently the actual decrease in traffic receipts amounted to £40,000; and that was mainly due to there being no elasticity whatever in the Australian traffic, and it was also due to two matters which now pressed very heavily upon the company. One was the very serious loss in exchange, due to the great depression in silver, which had become a very serious matter. The monetary standard of silver in the Straits Settlements, Hong Kong, and certain parts of China a year or two ago was 2s. for a Mexican dollar, whereas now owing to the great depression in silver it was only worth 1s. 7¼d. Hitherto they had collected their rates in silver, but they had now made up their mind to collect their rates in sterling, and to vary the rates of collection from time to time and to revise the rate every three months. By that means he hoped they would get rid of the loss of exchange. The other serious matter which pressed upon the company, apart from the question of Australian trade, was the reductions they had made in their tariffs. Those reductions had been very considerable. He had no doubt that some of them in the course of time would result in an increased volume of traffic which might to some extent get rid of the pressure on the company, but they had to consider the demands of commerce, and they had to reduce tariffs from time to time to keep pace with the universal cry for cheap telegrams. Their losses last year owing to these reductions had been £26,000. He had no doubt that in the future that loss to some extent would be replaced, but, as a matter of fact, it took a good long time to replace the money which they gave up by reducing tariffs. He might give an example in the case of the Australian traffic, which during the last three years had been reduced from 4s. 9d. to 3s. a word, but the actual traffic transmitted now was practically the same as it was when the higher tariff prevailed. That refuted the confident statement made by their critics that reductions of tariff invariably recouped themselves very quickly. The volume of traffic in the telegraphic world was dependent not so much upon the tariff as upon the state of trade between the various countries. The conditions of Australia had not been by any means favourable to business, and consequently, despite the reductions in tariff, there had been no increase in the volume of traffic. Turning to the expenditure, the working expenses had amounted to £121,000, against £115,000, showing an increase of £5,456. That was almost entirely accounted for by the opening of new stations in connection with their direct Cape—Australia cable and the general growth of expenditure. The result of the whole business was that their net profit for the half-year amounted to £148,000, out of which the usual interim dividends had been paid, and £73,000 was carried forward to the next account. The general reserve fund had been debited during the year with £69,000, on account of further expenditure in connection with the Cape—Australian cable, and after having been credited with £12,657 for interest on investments and the value of picked-up cables, there remained a balance of £912,965 to the credit of the reserve fund, which was by no means an unsatisfactory state of things. Since the close of the half-year they had contracted to supply and lay on behalf of the Netherlands Government a submarine cable between Balikpapan, in the Island of Borneo, and Kwandang and Menado, in the Island of Celebes—a distance of 700 miles. The cable had been manufactured by the Telegraph Construction and Maintenance Co., and would be conveyed to its destination and laid by two of their own repairing steamers, which were very nearly completed. Perhaps the most important matter was that the laying of the much-talked-of Pacific cable had been recently completed, and was expected to be open for traffic within a fortnight or three weeks. The tariff between this country and Australia by the new route would be the same as by their route—3s. a word. They, of course, knew that the Pacific cable was not a private enterprise, but had been established by the Governments of Great Britain, Canada, Australia, and New Zealand, to connect Canada with New Zealand and Australia *vid* the Pacific, and also to satisfy the somewhat sentimental notion for what was called an "all-British" cable. When they came to think of what was, and what was not, an "all-British" cable, he ventured to think that their connection with Australia, passing as it did through the Cape of Good Hope and then going direct to Great Britain, with the single exception of touching one small island belonging to Portugal, was to all intents and purposes as much a British route as the route that had been promoted by the Governments between Australia *vid* the Pacific. When the new cable was opened, competition with their system for the traffic between Australia and Europe would at once begin. They were not very glad to have competition, and he did not honestly believe that Australia would gain anything by it, but they did not look upon the competition with any violent amount of alarm, for they felt pretty certain they could offer to the public far greater facilities, and undoubtedly much greater certainty in the transmission of their messages, when they contemplated their vast network of cables, and the various routes they possessed, compared with the fact that the Pacific cable board had only one single line which had been laid with "swings" of a length from point to point, which were at present almost without parallel. They could not help noticing that almost for the first time the British and Colonial Governments had taken what was from most points of view a regrettable step in entering into competition with private enterprise; and in their case it was competition with a company to which he thought everybody must admit the credit was due of connecting Great Britain with all her Colonies and dependencies in every centre of trade. They asked now from all those Governments fair play and no favour, and they asked it not least of all from our own Government. In conclusion, the chairman briefly referred to the subject of wireless telegraphy, and said that, as he had remarked on previous occasions, they looked upon what was being done in that connection with a certain degree of interest, and he believed that, to a certain extent, it would be useful to them, but he never looked upon it as a serious competitor with cable enterprise.

The Marquis of Tweeddale seconded the motion, and the report was adopted.

British Aluminium Co.

The directors' report states that the profit for the year ended December 31st, 1901, calculated upon the same basis as in previous years, was £12,525. As this was insufficient to meet the debenture stock interest, depreciation on plant, &c., charges on stocks of metal, and other items detailed in the appropriation account, by £14,076, the debit balance has been increased from £4,888 to £18,965. Early in the current year the directors deemed it desirable to have an exhaustive examination made into the affairs of the company, and for this purpose they appointed Mr. J. S. Harmood Banner, of the firm of Messrs. Harmood Banner & Sons, chartered accountants, Liverpool. In the result it has been decided to reduce the item of patents and goodwill by £29,481, thus leaving it at £100,000, as shown in the balance-sheet. The stocks of metal and certain stores have also been valued at lower rates than before, following upon reduced prices in England. This has necessitated the writing down of values by £21,383. Further, the company having in 1897 contracted to purchase large quantities of aluminium in America, which were afterwards found to be in excess of requirements, an agreement was concluded with the sellers to cancel the order for the undelivered balance in consideration of the sum of £5,600 being paid to them. These amounts have been carried to a suspense account, together with others resulting from the writing down of sundry investments, losses on consignments of metal, provision for bad and doubtful debts, and for special expenditure incurred in connection with mines development, issues of new capital and the unsuccessful application for a prolongation of the company's principal patent, &c. The total, £80,238, is shown in the balance-sheet, and the directors suggest that for the present this item should not be dealt with. It will be remembered that in May, 1899, a revaluation of the company's property and works was made by Messrs. Wetherall & Green, and as a result the capital reserve fund of £227,451 was created. This fund has been reduced to its present figure of £185,984, by charging against it expenses incurred in issuing the company's debenture stock, and also depreciation of patents, plant, &c., as shown in the accounts for 1900. The directors propose to retain the balance now remaining as a reserve against the value of the property. The depreciation for 1901 on plant, buildings and office furniture, amounting to £6,345, has been charged to appropriation account. During the last few months there has been a distinct improvement in the sales of aluminium, but, notwithstanding this, the company was not in a position to pay the debenture stock interest due on the 1st inst. The directors accordingly consulted the trustees of the debenture stockholders, who sanctioned the above modifications for submission. With regard to carbide, there has since the end of 1901 been a considerable fall in the selling price, and the conditions under which it is being produced and sold are so unsatisfactory, that the directors are of opinion that unless more favourable arrangements can be made, the manufacture should be discontinued on the expiry of the current contract next spring, even though much of the plant which has been specially provided for that purpose would thus become useless. The negotiations referred to in the last annual report, with a view to an arrangement between all the aluminium producers, resulted in an agreement being arrived at. It has, however, since been disclosed that this company has not, as was intended, secured the full proportion of the aluminium business which belonged to it at the time the agreement was come to. Directly this became known to them, the directors took steps to obtain a rectification of the anomaly, and are firmly pressing the matter upon the parties interested. The directors regret to report the death of Mr. A. S. Bolton in December last. Mr. E. Ristori resigned the positions of director and managing director in May last. Mr. Frank Robinow and Mr. Henry Wolfenden have been elected directors of the company. Mr. Wolfenden's appointment will come up for confirmation at the annual meeting. Mr. Robinow, having been elected in the place of Mr. Bolton, will retire by rotation, in conjunction with Mr. J. D. Bonner, and both offer themselves for re-election. Mr. R. W. Wallace, K.C., last month resigned the position of chairman, retaining a seat at the board, and Mr. J. D. Bonner has been elected chairman *pro tem.*

A special meeting of the debenture stockholders of the above company, constituted by Trust Deed of November 30th, 1899, made between the company of the one part, and the Debenture Securities Investment Co., Ltd., and Mr. Peter A. M. Hoare as trustees of the other part, was held last Thursday at Winchester House for the purpose of considering the passing of a resolution assenting to certain proposed modifications of the rights of the stockholders against the company and its property, and to certain modifications of the Trust Deed which had been proposed by the company, and which were sanctioned by the trustees of the Deed for submission to the stockholders, and empowering the trustees with a view of effecting such modifications to concur with the company in executing a supplemental Trust Deed. The principal objects of the proposed modifications were:—

(1) To suspend for the period of two years from the date of the said supplemental trust deed the operation of Clause 10 of the said trust deed dated November 30th, 1899, and to relieve the company from the obligations on its part contained in such clause for the same period; (2) To postpone the payment of all interest, including the interest now due on the debenture stock until November 1st, 1903, and to authorise the trustees of the said trust deed, if they in their absolute discretion think fit, to consent on behalf of all the holders of the debenture stock thereby secured to postpone the payment of interest for a further additional period of one year. The company to give to the debenture stockholders deferred interest warrants for all interest so postponed, to be repaid after the expiration of the said period of one or two years (as the case may be) out of the first funds of the company which the trustees in their absolute discretion consider available for the purpose; (3) To empower the company or the trustees to borrow and raise the sum of £10,000 and interest thereon at such rate as the trustees may approve upon the security of all or any of the assets of the company, and in priority to the existing debenture stock. All sums of money so raised to be applied with the approval of the trustees; and, upon the sale of each ton of aluminium belonging to the company, and now deposited at warehouses, the sum of £50 shall be applied out of the proceeds of sale towards the reduction of the money so raised; (4) in consideration of the above modifications, the company to covenant with the trustees that, after the expiration of the said period of one year or two years (as the case may be), 25 per cent. of the net profits earned by the company in each year and available for dividend on the share capital of the company (after making all proper allowances for depreciation and other charges and allowances, and after payment of the interest on the debenture stock and the amounts due under the deferred interest warrants above referred to) shall be applied towards the redemption of the debenture stock in accordance with the provisions of the said trust deed, or in the purchase of debenture stock in the market. All stock so purchased to be purchased through the trustees and to be cancelled without power of re-issue; (5) to supplement and modify the powers of the trustees of the deed accordingly.

Mr. J. Bonner (chairman), who presided, said he had been nominated to the chair not so much because he was the chairman of the company, but as he was the representative of a large holder of the debenture stock, viz., one-fifth of the issue. Being so largely interested, it was natural that gentleman had followed very closely the course of events, and he was satisfied that the concessions solicited were the minimum which would give the company any prospects of earning within a reasonable time the interest on the debenture stock. He need hardly tell them that the directors regretted very much that they were under the necessity of having to vote for temporary accommodation for the company, but it was satisfactory to know that it was not a permanent sacrifice, and was only to enable the company to carry out in its entirety certain obligations it owed to them. As they were aware, the development of the aluminium trade in this country had proceeded very much more slowly than had been anticipated at the company's inception. He did not propose to enter upon the debateable grounds as to whether, if another policy had been pursued in the business of the company, that development might have been materially increased. He must say, however, that since certain changes had been effected in the board and the management of the company, there had been a marked improvement in the sales of the aluminium, and he might say that this year the sales would be nearly 40 per cent. more than last year. His colleagues and himself had every reason to hope that improvement would not only be maintained, but be progressive. For the first time that year, he was glad to say, a reduction had been made in their accumulated stocks, owing to the sales of metal having exceeded the production and purchases. Among the different causes that had contributed to the position in which the company found themselves was the large lock-up of capital in connection with the Loch Leven water-power power scheme. During the past two years about £30,000 had been expended on the scheme, and he believed that water-power was the largest capable of development in this country, and, under the trust deed, that asset became part of the security of the debenture holders, though, of course, the £30,000 expended remained unproductive until its development was proceeded with. Since the issue of the debenture stock the company had created an issue of preference shares, nearly the whole of which had been taken up by the junior classes of shares, who had in that way provided nearly £100,000 of capital ranking behind the debenture stock. Moreover, large loans of capital had been made to the company with a view of protecting the assets of the company. He mentioned those facts in order that they might see that the debenture holders had not been asked to give accommodation until the shareholders had been called upon to make large sacrifices to retain their reverseionary interests. It was thought by the directors that, owing to the extraordinary conditions under which the aluminium business was conducted, the policy they had now put forward was the best one in their interests. They could only have a faint conception of the great anxiety the directors had had to endure owing to the circumstances of the company, and he would submit that they could not reasonably expect the directors to develop the business to the fullest extent while that anxiety rested over their hands. Referring to the balance-sheet of the company for last year, he said they would notice that their liabilities were £41,000, and the amount due to the company was only £17,000, a difference of £24,000. That gave them an idea of the extremely difficult position which had to be faced, especially as the company had not begun to reduce its large stock of metal. At the end of last month their financial position, he was pleased to say, had greatly improved, as the sales had greatly increased this autumn. Having regard to all the circumstances of the case, he could assure them that it was most desirable that they should agree to the proposed modifications submitted to them. The first of the modifications did not interfere with the security that was assigned to them. As regarded the second, he would suggest that they would be well advised to have a little confidence in the trustees and the large holders of stock, who had looked well into the situation. The third modification provoked most opposition, and it was extraordinary that it should be so, especially as it was made in the interests of the stockholders. It was thought that it was proposed to borrow a sum which would always remain in front of the debenture stock. That was not the case, because the money had to be repaid to the extent of £50 for each ton of metal taken from the warehouses and sold, and, therefore, when 200 tons of metal had been sold, the debt would be wiped off. That contribution of £10,000 was important to the debenture holders if they wished to improve the position of the company, for it was necessary to conduct the business under more favourable conditions. The fourth proposal was that after one or two years, 25 per cent. of the profits earned every year and available for dividend, should be applied towards the redemption of the debenture stock. Perhaps this was rather a hard bargain for the trustees to enforce on the directors, but it would be of great advantage to the debenture holders, as it would preclude the possibility, when the company had turned the corner, of dividing the profits up to the hilt. He moved the following resolution:—"That the modifications of the Trust Deed, dated November 30th, 1899, as set forth in the draft Supplemental Trust Deed submitted to this meeting, be, and the same are hereby assented to, and the trustees are hereby authorised and directed to execute a supplemental deed in the terms of the said draft."

Mr. E. Crewdson seconded the resolution.

Some discussion then ensued, and Mr. Hoare moved the following amendment:—"That this meeting be adjourned until Friday, November 21st, and that the company and the trustees be requested to consider, first, increasing the sum named in the clause of the notice from £10,000 to £15,000; secondly, interest to be attached to the deferred interest warrants of 5 per cent. per annum; and, thirdly, to increase the 25 per cent. in Clause 4 to 50 per cent. until the debenture stock has been reduced to £200,000."

Mr. Chas Fletcher seconded this.

The Secretary of the Debenture Securities Co. pointed out that he had been approached by the directors of that company as the representatives of the debenture holders to raise the sum required to £20,000. The directors of his company had, however, after a long discussion at a meeting which was held, together with the advice of a gentleman who had thoroughly investigated the affairs of the company, decided to sanction only the obligation of the debenture holders to the extent of £10,000. His directors were fully convinced that the company had turned the corner, and had a great chance of increasing its business, and it was believed in two years' time that £10,000 would be paid off. He did not think it wise to put any fresh proposal before his board because the matter had been thoroughly thrashed out.

Mr. Hoare remarked that after that statement he withdrew his amendment.

The resolution was then put, and carried by 12 votes to 2.

West India and Panama Telegraph Co.

Mr. W. B. Kingsford, chairman, presided at Winchester House, Old Broad Street, E.C., on Wednesday over the fifty-first ordinary general meeting of the above company, and in moving the adoption of the report, referred to the fact that, owing to continued illness, Mr. W. S. Andrews had felt compelled to resign his position as chairman, an office he had held since the death of Mr. Earl. He was pleased, however, to say that Mr. Andrews had consented to remain on the board. Mr. Von Chauvin had also consented to continue to act as a director, and Mr. D. Le Rongetel had lately joined the board as the representative of the International Ocean Telegraph Co. With regard to the accounts, the receipts for the half-year showed a small decrease of £175, being £28,970, as against £29,145 in the corresponding period. On the other hand, the expenses showed a slight increase, being £22,399, as compared with £21,277. There had been a slight decrease in the London office, and in the maintenance of landlines, and in the depreciation account of the *Grappler*, which, it would be remembered, was lost last May. But against these decreases there was a sum of £500, which the shareholders voted last May to the *Groppler* Relief Fund. There was also a loss of £197 in cash, which was their bank balance at Martinique, and £224 had been spent in the hire of sloops to cover interrupted sections, and there were some small items, making a total increase of £1,132. The final results worked out thus:—The receipts were £28,970 and the expenses £22,399, showing a profit of £6,571. This, added to the balance of £4,079 brought forward from the last account, with interest on investments of £2,516, made an available total of £13,166, out of which the directors recommended the payment of 6s. on account of the arrears of dividend on the first preference shares. This absorbed £10,369, leaving a balance of £2,797 18s. 9d. to be carried forward. The *Grappler* was fully insured, and the underwriters had paid up at once, and there was a resulting small surplus of £1,400. The loss of the *Grappler*, as a matter of course, released her depreciation account, which at that time had a credit balance of £3,427, and this had been transferred to general reserve. Shareholders would probably remember that last July they received a circular from the board, informing them that their appeal to the House of Lords had been dismissed in

favour of the Cuba Co. Owing to the timely provision made by the board, they had practically covered what the Courts held was due to the Cuba Co. The difference between the amount they had to pay and the amount which they had set aside was only £3,175 11s. 6d., and this had been taken from the general revenue account and utilised in a final settlement of all matters in dispute between the two companies. Having due regard to the disasters abroad and litigation at home, he ventured to think that the accounts for the half-year might fairly be considered not to be unsatisfactory. To take the place of the *Grappler* they had contracted with Messrs. Napier & Miller, of Glasgow, to build a new ship to be delivered in the Thames in May. They would get not an ornamental, but a thoroughly good, strong and efficient ship. In the meantime they obtained the *Newington*, and it spoke well for Mr. Brown and the company that she was fitted up ready for the work she had to do in five weeks. Since then the *Newington* had been at the West Indies, and had repaired the duplicate Barbadoes cable for the original Grenada—Trinidad cable. The tug of war, however, began when they started to repair the Grenada—St. Lucia cable. The section was repaired, but within 48 hours it broke again. They then attempted to repair the St. Lucia—St. Vincent cable, but the work was interrupted by renewed volcanic disturbances, and the *Newington* had a very narrow escape of sharing the same fate as the *Grappler*. It would be absolute folly to continue repairing the St. Lucia—St. Vincent cable at present, and accordingly they had suspended operations, and must endeavour to possess their souls in patience until the return of a state of things less disturbed and perilous. It would be ungenerous if they did not recognise the excellent work of their cable and electrical staff under such unprecedented circumstances of combined difficulty and danger.

Mr. H. Holmes seconded the motion.

Several shareholders urged that the board should endeavour to arrange a conference with the Direct West India Telegraph Co. and the Cuban Co. to see if it was possible to arrange something which would benefit shareholders in West India cable companies.

The Chairman said he could only reply that they would take the matter into due consideration.

The report was adopted.

Companies Struck off the Register.

The following is a list of electrical companies which have just been struck off the register:—

Association for the Protection of Telephone Subscribers, Ltd.
Aurora Electric Lighting and Distribution Co., Ltd.
Bournemouth, Poole and District Light Railways (Electric) Co., Ltd.
British Carbide Manufacturing Co., Ltd.
East Grinstead Electric Lighting Co., Ltd.
Electrical Purification Association, Ltd.
Electric Cycle Syndicate, Ltd.
Electric Railway Omnibus Co., Ltd.
Electrograph Syndicate, Ltd.
Finchley District Electric Traction Co., Ltd.
Hermite International Electrical Sanitation Co., Ltd.
Improved Patent Forced Draught Furnace Syndicate, Ltd.
Kilduchevsky Mega Telephone Syndicate, Ltd.
Madrid Street Tramway Co., Ltd.
Portable Electric Lamp Co., Ltd.
Telephone and Switchboard Syndicate, Ltd.
Tyneside Electric Power Co., Ltd.
Weymersch Electric Battery Syndicate, Ltd.

Stock Exchange Notices.—The Committee has appointed a special settling day as under:—Wednesday, December 3rd.—British Insulated and Helsby Cables, Ltd.—Further issue of £250,000 4½ per cent. first mortgage debenture stock, and has also ordered same to be quoted in the Official List.

Blackheath and Greenwich District Electric Light Co., Ltd.—The issue of 50,000 7 per cent. cumulative preference shares to the holders of this company's ordinary shares and debenture stock was largely over-subscribed, and letters of allotment and of regret (to non-holders who have applied) have been posted.

Cape Electric Tramways, Ltd.—The directors have declared a dividend of 3 per cent., payable after the receipt of transfer returns from South Africa.

Dorman, Long & Co.—The directors have declared a final dividend of 3½ per cent., making, with the interim dividend, 6 per cent. for the year.

STOCKS AND SHARES.

Wednesday Evening.

Another vigorous shake-out in the Kaffir market has sent a corresponding dulness through most of the departments of the Stock Exchange, from Consols downwards, and the only spot which escaped the influence of the collapse was the home railway section. In the latter a revival of public interest has been quickened by reason of the good receipts now being secured by nearly all the lines. Electric railway stocks, buoyant a few weeks ago, at a time when depression ruled in the steam department, are somewhat langourous now that the public has turned its attention to the older issues. A number of new issues by companies in the electrical supply and manufacturing lists are a feature of interest. Telegraph stocks remain somewhat supine, but telephone issues continue their quiet appreciation, and there is little stock on offer in the market.

The renewed controversy over the Corporation contract has brought about a fall of 10s. in City of London Electric Lighting Preference shares, which are down to 13½. Charing Cross descriptions have not changed, notwithstanding some startling figures adduced by Mr. A. C. Morton at last week's meeting of the City Corporation. Westminsters are a dull market, and although the lighting department should now begin to reflect in its rising prices the dark days of winter, the general list is decidedly featureless. South London Electric are harder, and it is believed that the shares have commanded attention by reason of the South London Tramways contract. Rumours are current with regard to a new issue of Preference shares by a very well-known Supply Co., but the promoters are hedging the details with all kinds of prohibitions in regard to publication of the company's name. But, perhaps, 5⅞ may not be far off the issue price of the shares when they appear.

Blackheath and Greenwich new Preference are a good market, and already command a premium of about half-a-crown over the issue price of a guinea. It is understood that the company is now doing very much better, and the Ordinary shares have risen ½, whilst the Debenture stock is up a couple of points. In view of the valuable privileges which this stock possesses in the shape of the right to convert it into Preference shares, it looks cheap at anything under 115, and will probably go to 120. The difficulty is, however, to secure any of it in the neighbourhood of the present quoted price of 110.

While triumphant success crowned the Blackheath issue, the British Electric Traction's offer of new Preference shares at 12 was received with a good deal of indifference on the public's part. It was remarked last week that there was "not much to 'go for' from the point of view of the stag," and the fact that no premium has been established on the shares is sufficient commentary. The old Preference themselves are only 17, and the Ordinary have relapsed ½ this week, a few sales of these having been effected by some of the shareholders who wanted to apply for the new Preference. Moreover, there are others who do not much care for the way in which the capital of the company is being increased. British Westinghouse Ordinary are a good market at 7 3/16, and the Preference at 6¼, the company having secured the contract for the instalment of the New Clyde Valley Electrical Power undertaking, which is about to commence operations on a scale of some magnitude along the Clyde Valley. There is no change to report in the London United Tramways issues, and the company's long Parliamentary notice has very little interest for the market.

Electric railway stocks, as already mentioned, are inclined to be dormant, the attitude of the various conflicting powers inducing caution on the part of the Central London and City and South London supporters. City Ordinary stock, it may be observed, is now quoted at a 1 per cent. margin between the higher and lower prices, a closing of the quotation such as we are always glad to welcome. With the public in a favourable mood towards Home Railway stocks, but little has been said in the Stock Exchange in reference to the threatened competition by electric traction in Lancashire whereby even the goods traffic of the steam lines is threatened by the more modern electric system. The Hove Town Council is seeking powers for running electric tramways in its borough; another little snub for the British Electric Traction Co., which is said to have had designs upon the trams of the quaint old port. Both the Brighton and the Great Eastern Railways are seeking electrical powers from Parliament.

Chili Telephone shares are ¼ better, and so are United River Plates. Another rise of a point has occurred in National Telephone Deferred stock, with which the market is none too freely supplied. Incidentally, it is interesting to note that the telephone between Rome and Paris is expected to be ready for service next month—a preliminary step, no doubt, to an extension to our own metropolis, which is, of course, already connected to the gay city. Monte Video Telephone shares of both classes are now *ex* dividend, but no change has taken place in the quotations.

Beyond a further addition to the prices of West India and Panama first Preference and Indo-European shares, the telegraph market is almost immobile. As showing the greater confidence of investors in these stocks, it is worthy of notice that all the talk about the new Pacific cable has failed to depress prices in the Eastern group. The Eastern Extension Co.'s new cable ships, now finishing on the Tyne, will soon be able to start their work of laying a cable between the islands of Borneo and Cellebes for the Dutch Government, but the shares have receded ¼ on the week. Marconi shares keep about 3¼, despite the amusing (to outsiders) stories which are sent from the United States in regard to Signor Marconi's financial adventures.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Nov. 12th.	Closing Quotations Nov. 19th.	Business done week ended Nov. 19th, 1902. Highest	Lowest.
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	3¼— 4½	3¼— 4½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	7s/6	3½%	6½s.	49 — 52	49 — 52	..	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	93 — 95	93 — 95	95	93½
3,105,580	Do. do. do. Deferred	Stock	£1 7s.	5s. %	2s.	8¼— 9	8¼— 9	8⅛	8⅛
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	5 %	5 %	3¾— 4¼	4 — 4¼	4⅛	4
18,383,300$	Commercial Cable	$100	8 %	8 %	8 %	178 —188	178 —188	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	96	95½
16,000	Cuba Telegraph	10	7 %	4½%	4 %	5 — 6	5 — 6	..	..
6,000	Do. 10 % Pref.	10	..	..	..	12½— 13½	12½— 13½	..	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¾— 3¼	2¾— 3¼	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
60,710£	Direct United States Cable	20	3¾%	3¾%	3¾%	10½— 11	10½— 11	10½	..
96,300	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	99 —102	100½	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	124 —129	124 —129	126	124
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	89 — 92	89 — 92	89½	89
1,534,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	106½	104½
300,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	11¾— 12¼	12¼	11⅞
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	107 —110	107 —110	..	..
300,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	5¼%	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102 %	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5¼%	5¼%	5¼%	9½— 10	9½— 10	9⅝	9⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 13¾	13½— 13¾	13⅞	13⅝
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	15 %	15 %	27 — 28	27 — 28	27½	..
70,000	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	100 —103	100 —103	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	38 — 42	39 — 43	38¾	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	101 —105	101 —105	..	..
72,680	Montevideo Telephone, Ltd., Ord. Nos. 1 to 72,680	1	2½%	..	..	⅛— ¼	⅛— ¼ xd	..	..
86,492	Do. do. 5 % Pref., Nos. 1 to 86,492	1	5 %	..	..	½— 1	½— 1 xd	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	5 %	92 — 94	92 — 94	93⅞	92½
1,966,667	Do. do. Def. Stock	100	..	60	64 xd	58 — 60	61 — 63	60½	59½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½— 12½	11½— 12½	..	..
250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	4¾— 5⅛	4¾— 5⅛	..	..
2,000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 98	95 — 98	96½	95
600,000	Do. do. 4 % Deb. Stock Red.	100	..	4 %	4 %	101 —105	101 —105	102½	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	5 %	6 %	6 %	⅞— 1	⅞— 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	99 —102	99 —102	..	..
11,839	Reuter's	8	5 %	5 %	5 %	6¾— 7½	6¾— 7½	..	..
3,303	Submarine Cables Trust	Cert.	..	..	..	110 —120	110 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	4⅜— 5¼	5 — 5¼	5¼	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5	4½— 5	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	..	..	3 — 4	3 — 4	..	..
30,008	West Coast of America, Nos. 1 to 30,000 and 53,001 to 58,008	2½	..	..	..	0 — ¼	0 — ¼	..	..
150,000£	Do. do. 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	98 —101	98 —101	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	11½— 12	11½— 12	12	11⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	102 —105	102 —105	101½	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	99 —102	99 —102	..	..
88,321	West India and Panama Telegraph	10	⅝%	⅛%	..	⅝— ⅞	⅝— ⅞	⅞	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	4½— 5½	5 — 5½	5	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	5½%	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	75 — 80	75 — 80	..	..
100,000	British Electric Traction	10	8 %	9 %	9 %	12¼— 13¼	12¼— 12⅞	13	12⅞
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	11½— 12¼	12½	12⅛
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	124 —127	123 —126	125½	124
100,000	British Insulated Wire Ord.	5	20 %	15 %	10 %	7¾— 8	7¾— 8	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	103 —106	103 —106	..	..
50,000	¶Browett, Lindley & Co. (1899), Ord.	£1	..	8 %	..	13s. to 15s.	13s. to 15s.	13/9	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	..	6 %	..	16/6 to 17s.	16/6 to 17s.	16/6	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5½%	5 %	Nil	⅞— 1¼	⅞— 1¼	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	3 %	1 — 1¼	1 — 1¼	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	94 — 99	93 — 98	..	..
35,000	Callender's Cable Construction shares	5	15 %	15 %	20 %	15 — 16	14¾— 15¾	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5¾— 6¼	5¾— 6¼	5⅞	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	109 —113	109 —113	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	..	4 %	106 —109	106 —109	108	107
494,093	Do. do. 4 % Pref. Stock	Stock	..	..	4 %	108 —109	106 —109	..	..
494,993	Do. do. Def. do.	Stock	..	..	4 %	106 —109	106 —109	107¾	107½
1,330,000	City and South London Railway	Stock	1¾%	1¾%	2 %	75 — 77	76 — 77	78	76¾
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	8 %	7½%	2¾— 2¾	2¾— 3	2⅞	2⅞
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	101 —106 %	101 —106 %	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	6 %	2½%	..	⅛— ⅜	⅛— ⅜	⅜	..
17,139	Do. do. "A" shares, 01—017,139	5	6 %	2½%	..	1¼— 2¼	1¼— 2¼	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	74 — 78	74 — 78	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	77 — 82	77 — 82	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾— 2	1¾— 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¼— 2⅞	2¼— 2⅞	..	..
182,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	99 —102	99 —102	101	100
35,000	General Electric Co. (1900), 5 % Cum. Pref.	10	..	5 %	5 %	10 — 10½	10 — 10½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	99 —102	99 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	15 %	20 %	20 %	16¼— 17⅛	16¼— 17⅛	17⅛	17
35,000	Do. do. 4½ % Pref.	5	4½%	4½%	..	5¼— 5⅞	5¼— 5⅞	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	109 —113	109 —113	112	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	20½— 21½	20½— 21½	21½	20½
300,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	99 —102	100 —103	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	1½%	5¼— 5¾	4⅛— 5⅜	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	..	..	9¼— 10½	9¼— 10½	..	..
7,500	Parker (Thomas), Ltd., Ord., Nos. 1 to 7,500	10	..	..	..	14½— 15½	14½— 15½	..	..
	§Rosling & Fynn 6 % Cum. Pref.	£1	..	6 %	..	19/0 to 20/0	..	..	..
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	20 %	37 — 40	37 — 40	38½	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	102 —105	102 —105	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	93 — 96	94	..

† Quotations on Liverpool Stock Exchange.
§ From Bradford Share List.
‡ Unless otherwise stated all shares are fully paid.
¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, ⅛—¼.
National Electric Free Wiring, ½—1.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 13—14.
Do. do. Pref (£10 pd.), 10—11.

Bank rate of discount 4 per cent. (October 2nd, 1902).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1899.	1900.	1901.	Closing Quotations Nov. 12th.	Closing Quotations Nov. 19th.	Business done week ended Nov. 19th, 190 Highest.	Lowest.
		‡							
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	£1	..	..	..	⅜ — ½	⅜ — ½	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	106 —109	110 —113	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	6 %	8 %	10½ — 10⅝	10½ — 10⅝	..	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10½ — 10⅝	10½ — 10⅝	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	9 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	..
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	4⅛	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	105 —107	105 —107	106½	106½
44,436	*Chelsea Electricity Supply, Ord.	5	6 %	5⅓%	4 %	5⅛ — 6	5⅛ — 6	5⅜	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	109 —112	109 —112	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	4 %	0 %	5 %	10 — 11	10 — 11	10⅞	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	..	13½ — 14½	13 — 14	13⅞	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	123 —128	123 —128	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	104 —107	104 —107	105	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8½ — 9⅛	8½ — 9⅛	..	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	..	11½ — 12⅛	11½ — 12⅛	..	..
400,000‡	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	109 —112	109 —112	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	6 %	7 %	7 %	6 — 6¼	6 — 6¼	6¼	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6⅛	6⅛
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	11 %	12 %	10 %	10 — 11	10 — 11	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	101 —104	101 —104	..	..
110,000	ondon Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4⅞ — 5⅛	4⅞ — 5⅛	5⅛	5
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	98	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	5 %	6 %	6⅔%	15⅝ — 16⅛	15⅝ — 16⅛	..	..
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	99 —102	99 —102	..	..
10,852	Notting Hill Electric Lighting	10	7 %	7 %	6 %	14 — 15	14 — 15	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14⅔%	14⅔%	14⅔%	14⅝ — 15⅛	14⅝ — 15⅛	14	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	8⅝ — 9⅛	8⅝ — 9⅛	5	4⅞
150,000‡	Do. do. do. 3½% Deb. Stock Red	100	..	..	..	98 —101	98 —101	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	..	1⅞ — 2⅛	1⅞ — 2⅛	..	..
50,000‡	Do. do. 4% Deb.	100	..	..	..	80 — 90	80 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	..	2⅞ — 3⅛	3 — 3⅛	3⅛	..
30,000	Urban Electric Supply, Ord., £4 pd.	5	..	..	..	3⅝ — 4⅛	3⅝ — 4⅛	4⅛	..
30,000	Do. do. 5 % Cum. Pref., £4 pd.	5	..	..	..	3⅝ — 4⅛	3⅝ — 4⅛	4⅛	..
110,000	Westminster Electric Supply, Ord.	5	13 %	10⅔%	10⅔%	11¼ — 12⅛	11 — 12	11⅛	..
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6¼	6 — 6¼	6¼	6⅛

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, November 19th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	42/-	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	£33 10	..
a ,, ,,	per ton	£30	£30	..
a Bleaching powder	per ton	£4 10	£4 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£13	£13	..
a Bensole (90%)	per gal.	7/-	7/-	..
a ,, (50/90%)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£19	£19	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks	per lb.	3d.	3d.	..
a ,, Caustic (75/80%)	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	130/-	130/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 5	£6 5	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70%)	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks	per lb.	2½d.	2½d.	..

METALS, &c.				
b Aluminium Ingots, in ton lots	per ton	£148	£148	..
b ,, Wire, in ton lots	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£40 to £130	£40 to £130	..
c Brass (rolled metal 2' to 12') basis	per lb.	6¼d.	6¼d.	..
c ,, Tube (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	6½d.	6½d.	..
c ,, Wire, basis	per lb.	6¼d.	6¼d.	..
c Copper Tubes (brazed)	per lb.	8¼d.	8¼d.	..
c ,, ,, (solid drawn)	per lb.	9d.	9d.	..
g Copper Bars (best selected	per ton	£67	£67	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£67	£67	..
g ,, Rod	per ton	£67	£67	..
e ,, (Electrolytic) Bars	per ton	£65	£65	..
e ,, ,, Sheets	per ton	£74	£74	..
e ,, ,, Rod	per ton	£65	£65	..
e ,, ,, H.C. Wire	per lb.	7¼d.	7¼d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/4½	1/4½	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/2 to 3/5	3/2 to 3/5	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	50/3	50/11	8d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	£9 15	..
g Lead, English Ingot	per ton	£11 to £11 2 6	£10 17 6 to £11	2s. 6d. inc.
g ,, ,, Sheet	per ton	£13	£13	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bot.	£8 15	£8 15	..
d Mica (in original cases) small	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large	per lb.	3/3 to 7/3	3/3 to 7/3	..
p Phosphor Bronze, plain castings	per lb.	11½d. to 1/2	11½d. to 1/2	..
p ,, rolled bars & rods	per lb.	1/- to 1/3	1/- to 1/3	..
p ,, ,, strip & sheet	per lb.	From 1/2	From 1/2	..
o Platinum	per oz.	£4	£4	..
p Silicium Bronze Wire	per lb.	9d. to 1/-	9d. to 1/-	..
i Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	£58	..
i ,, ,, in bars		From £15 to £40	From £15 to £40	..
g Tin, Block	per ton	£114 to £115	£118 to £119	£4 dec.
g ,, Foil	per lb.	1/6	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/6½	1/6½	..
p White Anti-friction Metals— "White Ant" brand	per ton	£36 to £60	£36 to £60	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7d.	7d.	..
j ,, 6 lea. Flax	per lb.	5¾d.	5¾d.	..
j ,, 3 ply 10 lbs. Russian	per lb.	4¼d.	4¼d.	..
j ,, 10 lbs. Russian, single	per lb.	4½d.	4½d.	..
j ,, 180 lbs. Jute rove	per ton	£11 11	£11 11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£23	£23	..

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons., Ltd. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Edward Till & Co. *i* Messrs. Bolling & Lowe. *j* Messrs. Walter H. Hindley & Co., Ltd.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited. *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company Ltd.

TRAFFIC RECEIPTS.

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
Blackburn Corp. Trys.	Nov. 14	702	+ 31	28,057	+ 3,741	12½	12½
Blackpool and Fleetwood	,, 15	209	+ 56	19,798	— 200	7½	7½
Bristol Trys. & Car. Co.	,, 14	4,000	+430	—	—	28	28
British Elec. Trac. Co.:—							
Devonport	,, 7	427	+ 34	19,383	+ 1,181	5	5
Dudley—Stourbridge	,, 7	775	+177	33,794	+ 4,122	18½	18½
Gateshead	,, 7	955	+248	38,822	+ 6,547	10½	9½
Gravesend—Northfleet	,, 7	191	—	2,997	—	3½	—
Greenock—Pt. Glasgow	,, 7	495	+212	22,532	+13,078	7½	7½
Hartlepool	,, 7	242	+ 31	11,412	+ 1,120	6½	4½
Kidderminster	,, 7	107	+ 15	5,613	+ 48	4½	4½
Merthyr	,, 7	172	— 25	8,993	— 1,339	8	8
Middleton	,, 7	241	—	9,737	—	8½	—
Oldham—Ashton	,, 7	844	+113	23,899	+ 1,944	8	8
Poole	,, 7	245	+ 22	11,725	— 73	3½	3½
Potteries	,, 7	1,651	+290	66,651	+ 3,690	28½	28½
Rothesay	,, 7	48	+ 17	1,731	+ 559	—	—

Company.	Week ending	Receipts for the week. Am'nt.	Inc. or dec.*	Total to date. Am'nt.	Inc. or dec.*	Miles open. This year.	Last year.
		£	£	£	£		
B.E.T. Co. (*continued*)—							
Southport	Nov. 7	247	+121	11,635	+ 4,137	5½	5½
South Staffordshire	,, 7	727	+ 57	23,989	— 989	21½	25½
Swansea	,, 7	438	+ 40	21,281	+ 1,868	5½	5½
Taunton	,, 7	54	— 2	2 938	— 328	1½	—
Tynemouth	,, 7	241	+ 46	13,447	+ 1,897	9½	9½
Weston-super-Mare	,, 5	45	—	5,378	—	2½	2½
Wolverhampton Dist.	,, 7	389	+135	9,518	+ 6,180	10½	8½
Central London Railway	,, 15	7,358	+549	131,545	+10,759	6	6
City and S. London Ry.	,, 16	3,429	+958	54,859	+10,212	6½	4½
Doncaster Corp. Trys.	—	—	—	—	—	5½	—
Dover Corporation Trys.	,, 15	182	+ 0	10,185	+ 71	3	3
Dublin United Trys.	,, 14	4,203	+270	97,521	+ 2,555	46	46
East Ham Tramways	,, 15	452	+152	10,676	+ 2,160	5	4½
Glasgow Corp. Trys.	,, 15	12,673	+2,227	294,762	—11,445	57½	49
Liverpool Overhead Ry.	,, 16	1,552	+161	31,183	— 968	6½	6½
Newcastle Corp. Trys.	,, 15	3,076	—	—	—	35	—
Sunderland Corp. Trys.	,, 16	1,002	+ 5	20,726	+ 2,768	17½	17½

* Compared with the corresponding period of 1901.

BRITISH ASSOCIATION, BELFAST, 1902.

RECENT PROGRESS IN LARGE GAS ENGINES.

By Herbert A. Humphrey, M.I.Mech.E., A.M.I.C.E., M.I.E.E.

(Abstract of Paper read before Section G, September 11th.)

(Concluded from page 839.)

Fig. 14 shows the interior view of the Düdelingen power-house. The nearest engines are 600 H.P. each, and the two sets at the far end are 1,000 H.P. each.

The Deutz Co. have other engines driving alternators in parallel at Romanshorn, Switzerland.

The double-acting Körting engines, as recently perfected, will doubtless be largely used for driving alternators in parallel. In the meantime, fig. 15 shows half of the Julienhütte station, with three Körting twin-cylinder single-acting 300 H.P. gas engine sets, the alternators being supplied by the same makers. These three-phase alternators have 40 poles, and their speed is 140 revolutions per minute, the frequency being 46⅔. The angular cyclic variation calculated in degrees for a bipolar system is 3·8°, and the weight of the rotating parts multiplied by the square of the diameter of gyration is 325,000 kgm.^{2} The photograph is taken from the centre of the station, and the small direct-current 50 H.P. set in the foreground is for separately exciting the alternators. A motor-generator is also seen, comprising a 50-H.P. asynchronous motor, coupled to a 33-KW. direct-current dynamo. The parallel running is particularly good in this station; the load is principally asynchronous motors; but three synchronous motor-generators for converting to direct-current are being added. Two 1,000-H.P. units will soon be ready for working at this station.

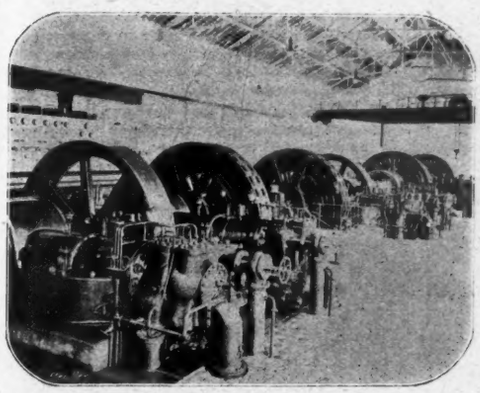


Fig. 14.

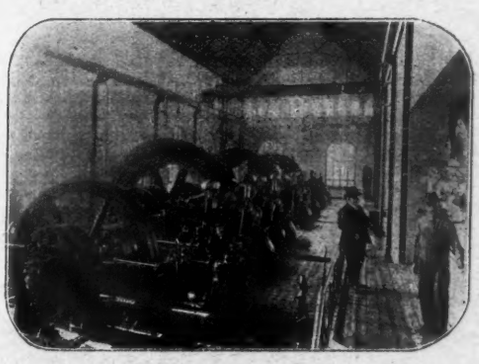


Fig. 15.

Körting Bros. have also furnished gas-driven alternator sets to the Mansfelder Kupferschiefer bauenden Gewerkschaft at Eisleben, and to the Markircher Berg und Hüttenverein at Markirchen in Elsass; and both these firms testify to the perfectly satisfactory parallel running of their alternators.

A double tandem 600-H.P. Cockerill engine, with four single-acting cylinders, coupled to a 450-KW. three-phase generator, is working in parallel with two steam-driven generators. The speed is 150 revolutions per minute, and the frequency 25 cycles per second. The plant is installed at Kladno Steel Works, in Bohemia, and the engine was made by Breitfeld, Danek & Co., of Prague. The cyclic variation is $\frac{1}{300}$, with a fly-wheel 18 ft. diameter, and weighing 28 tons. It is most interesting to note that, in the first place, only one-half of the complete engine was delivered and set to work; and although under these circumstances the cyclic variation was as much as $\frac{1}{110}$, yet the generator thus driven ran quite well in parallel with the steam engines. This engine was described by Mr. A. C. Eborall in his paper before the Manchester Section of the Institution of Electrical Engineers. An electric eddy-current brake is applied to the fly-wheel, in order to provide an artificial load up to some 300 H.P., when putting the generator in parallel with others. The brake is very simple, and consists of an electro-magnet, requiring but little energy in the shape of a small amount of direct current, which can easily be regulated in strength according to the brake-power wanted. In addition, there is provided an adjustable three-phase choking coil, to limit the synchronising currents during the adjustments. Both the brake and the choking coil are put out of use when the alternator has taken up its load.

Westinghouse sets have proved themselves quite equal to parallel work with direct-connected alternators.

Fig. 16 is a view of one of three 250-H.P. sets at the works of the Metropolitan Railway Carriage and Wagon Co., Birmingham, which run well in parallel. Each generator is of 150 KW. capacity, yielding two-phase current at 220 volts per phase when running at 200 revolutions per minute. The exciter is belt-driven; the armature is of the slotted core ironclad type, and there are 36 laminated poles. The load consists chiefly of Westinghouse Size C alternate-current induction motors, which are self-starting under load.

The Brymbo Steel Co. are fitting up their works with 500 to 600 H.P. Westinghouse gas engine alternator sets. The generators will run in parallel, and furnish power and light for the works.

In connection with parallel running, one of the most interesting Westinghouse installations is that now erecting in Buenos Ayres for the Great Southern Railway Co., South America, where the engines will be worked by Mond gas. The 1,500 B.H.P. required will, on account of the peculiar load curve, be divided into 250-H.P. units. The engines are direct-connected to three-phase alternating-current generators, supplying low voltage current for motors and for incandescent and arc lighting throughout the railway shops and yards, and at high voltage for distribution to furnish light and power to railway yards, passenger stations and docks, 10 to 15 miles away. The fuel cost per unit will be one-third only of the cost, if high-class steam engines were used.

The theory of alternators working in parallel has been so wrapped up in the mystery of mathematical formulæ, and expressed differently by every writer who has made it his pet subject, that a statement of a few of the leading facts may be welcome.

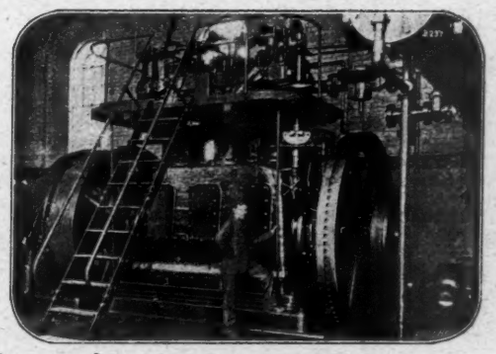


Fig. 16.

The cyclic variation of the driving engine must be maintained within certain limits, depending on the design of the dynamo and the character of the load, the most important factors being the self-induction and reaction, and the short-circuit current of the alternator, the speed, and the number of poles. Parallel running is facilitated by low frequency and high speed of rotation, by armatures with a good deal of self-induction, and by a non-synchronous load. When the load includes synchronous motors, and still more with rotary converters, a more uniform driving torque is needed; but no case occurs in practice which cannot be dealt with in a perfectly satisfactory manner by a properly designed multiple-cylinder gas engine. In ordinary cases where the periodicity does not exceed 50, the cyclic variation may be approximately $\frac{1}{100}$, varying from $\frac{1}{130}$ to $\frac{1}{300}$ according to the special circumstances. Under the most unfavourable conditions of load, $\frac{1}{200}$ is good enough with well-designed alternators. Gas engines are already running with a cyclic variation of $\frac{1}{130}$, and this with fly-wheels of quite moderate weight, and the makers are prepared to guarantee even better results in the very exceptional cases where they might be required. Except by limiting the cyclic variation, fly-wheels do not assist in parallel running. In fact, it is quite possible to increase the maximum phase displacement by increasing the moment of inertia of the rotating parts beyond a certain limit, as has been shown by Mr. H. C. Leake, among others. Whenever a relative displacement takes place between two alternators in parallel, cross-currents occur, the work of the leading generator is increased, and that of the lagging generator diminished, and the alternators tend to pull one another into phase. The synchronising force is greater the greater the phase displacement, so that the leading generator has been putting energy into the fly-wheel of the lagging generator all the time that the latter is lagging

and catching up again. The cumulative effect of this fly-wheel acceleration is to make it overshoot the correct mean speed, just as a common pendulum swings beyond its mean vertical position; and it is in this swinging that the weight of the fly-wheel plays an important part, by regulating its amplitude and periodicity, which may reach values leading to unfavourable results, and possibly produce resonance effects. Consequently, the fly-wheel should be made the last resource for securing a good cyclic variation, and attention first devoted to obtaining a uniform crank effort by an increased number of equally timed impulses per revolution, and a good balance of the reciprocating parts. Resonance effects are not often to be feared, and can readily be prevented, but engines and generators should not be assembled without making the necessary calculations to prove the remoteness of such effects.

So far the cyclic variation in speed has been spoken of as if it depended only on the engine, yet the dynamo maker has in his hands the means of reducing the variation independently of the engine. If, instead of having the poles and shoes of alternators laminated, they are made solid, the parallel running will be assisted. Still more is this the case if copper bridges are made to stretch between and around the poles, for then any change in angular velocity, disturbing the distribution of magnetic flux in the air gap, causes damping currents tending to check such variations in velocity, and prevent the swinging previously mentioned. Again, one can go a step further, and pierce the poles with a number of holes to receive a squirrel cage of copper bars with their ends short-circuited. This last arrangement has the important advantage that the alternator will then act as an asynchronous motor, and if one of two alternators in parallel has its field exciting current broken through any cause, the other will keep it turning as a motor. Should the gas engine fail to ignite its charges, still its alternator would keep going as an induction motor and complete breakdown be prevented, giving the attendant time to put matters right. The arrangement means additional expense and some small waste of energy, and it is not suggested that in every case it is necessary, or even advisable, but it shows what extreme safeguards are possible.

The governing of gas engines is in some ways superior to that of steam engines, as there is less risk of surging and hunting; but with gas engines for alternators in parallel, the governors should possess similar characteristic curves and degrees of stability. The margin of speed between no load and full load should not be too narrow; never less than 3 per cent.

The recent remarkable progress in large gas engines outlined in this paper will undoubtedly continue until Sir Frederick Bramwell's prophecy of 21 years ago, made before this Association in 1881, has been fulfilled, and steam engines will only be found in museums. Already one can chronicle a case where gas engines of 6,000 H.P. are to be employed in transmitting three-phase current from Ilseder-Hütte to rolling mills at Peine, a distance of 5 miles; and the present installation of steam engines of 2,000 H.P., although of excellent type and not three years old, will be superseded.

An addition to their steam plant of a 3,000-H.P. gas engine is contemplated by the Glasgow Corporation, and a double-cylinder Körting engine has been offered them. This shows that the question of large gas engines is stirring in the minds of central station engineers.

A change which means the replacing of boilers and steam engines by gas producers and gas engines, and is accompanied by a saving of more than half of the coal, cannot be averted. Moreover, by the Mond process the gasification of a ton of coal leads to the recovery of 90 lb. of sulphate of ammonia worth 8s.; and one has only to recall Prof. Crookes' presidential address to realise that this valuable manure will become more and more necessary for the production of our food stuffs. The author has already obtained with a large gas engine a thermal efficiency of 34 per cent., using producer gas; and it will not be surprising if in a comparatively short time a 40 per cent. efficiency is reached. It is earnestly to be hoped that British manufacturers will not be behind in helping to realise these results, by actively promoting the development of the large gas engine, which is *the engine* of the century.

The author's cordial thanks are due to the directors, managers and engineers of the several companies mentioned in this paper, for their kindness in conducting the author round their works, answering questions and supplying information, photographs and drawings.

INSTITUTION OF ELECTRICAL ENGINEERS.

The chief arrangement which had been made for last week's meeting of the Institution of Electrical Engineers at Westminster was the delivery of Mr. James Swinburne's presidential address. It was, however, found on the morning of the 13th inst. that Mr. Swinburne was too unwell to be present in the evening, although his illness, we are happy to add, was said not to be of a serious nature. It is quite essential that such an exceptional address as the President had prepared should be delivered by that gentleman personally, therefore it was considered wise to defer this part of the proceedings until his indisposition had passed away. This decision was the only one which could be fairly arrived at, both in justice to the address, and in consideration for Mr. Swinburne himself.

We were unable to make reference to the altered arrangements in our last issue, for very good reasons; the Review had to be out of editorial hands long before the absence of Mr. Swinburne was known to be certain, and our pages were actually printing at the time the meeting was opened.

What did transpire at the meeting was as follows:—

Mr. John Gavey, Vice-President, took the chair. Reference was made to the death of three distinguished members of the Institution, who had died during the recess, viz., Sir Frederick Abel, Dr. J. H. Gladstone, and Prof. Sidney H. Short.

Prof. W. E. Ayrton has resigned the hon. treasurership, and Mr. Robert Hammond was appointed to that office.

The preliminary arrangements for the visit to Italy next year were announced as follows:—

Party to travel *viâ* St. Gothard route, leaving England Thursday, April 2nd, arriving at Como April 3rd, leaving for Milan April 6th, and dispersing at Milan April 9th, the day before Good Friday.

A very cordial invitation has been received from the President of the American Inst.E.E. The Chairman stated that on account of the visit to Italy in 1903, the American visit could not be arranged for that year, hence the Council had accepted for 1904. It is understood that an invitation is to be expected from Canada, and it is probable that ultimately an arrangement will be made to visit both the United States and Canada, holding a meeting in the latter place. This would give members the opportunity of visiting the St. Louis Exhibition, even if no official visit should be arranged to that centre.

It was reported that as an immediate outcome of the deputation to the Board of Trade, there was reason to believe that the question of Board of Trade regulations was receiving the most careful reconsideration.

In regard to the correspondence with the Home Office, *re* Factory Act, the Institution has been assured that full opportunity will be afforded for the discussion of Regulations before they are adopted. There is reason to hope that the Secretary of State may see his way to give what assistance to the profession is possible under the present Act in regard to the employment of "young persons" in electricity works.

As already stated in our columns, the President of the Institution has been appointed to serve on the Committee nominated by the Home Office to inquire into questions relating to the use of electricity in mines.

Reference was made to the Code of Etiquette approved by the Council for Consulting Engineers, amongst whom quite a flutter has recently been apparent.

The original proposals of the Council respecting subscription rates have been somewhat modified. They now propose that all subscriptions shall be unified up to the present maxima, subject to no subscription at home being less than £2 2s., or abroad less than £1 11s. 6d., with the exception of foreign members (a small class of exceptional character) and students. The rules for students are to be altered, allowing them to remain in that class until they are 26 years of age, but paying for the period of extension £1 11s. 6d. instead of £1 1s. per annum, this enabling the student to pass, if he wish, and if qualified, direct into the class of associate members. The new rates proposed are as follows:—

	Home.	Abroad.
Members	... £3 3 0	£2 2 0
Associate members	.. 2 2 0	1 11 6
Associates ...	... 2 2 0	1 11 6
Students: senior	... 1 11 6	1 11 6
Students: junior	... 1 1 0	1 1 0
Foreign members	... 3 3 0	1 0 0

At the same time, *Science Abstracts*, which is not valued equally by all the membership, is to be supplied only to those willing to pay a small subscription. The publication is to be divided into two parts, "Engineering" and "Physical Science"; the two parts together to be supplied to members at 7s. 6d. per annum (the price to the public is 24s.), the "engineering" portion alone to be supplied to members at 5s. per annum. A circular is shortly to be issued to members, and statutory meetings of full members (M.I.E.E.) are to be called for considering alterations to the articles of association.

A list of some of the papers promised for the session was read, the date of the annual dinner announced, and the premiums presented as per list published in annual report.

The next meeting called is for Thursday, November 27th, when a paper on "Electrons" will be read by Sir Oliver Lodge, F.R.S.

NOTES ON THE TESTING OF TRAMWAY MOTORS, AND AN INVESTIGATION INTO THEIR CHARACTERISTIC PROPERTIES.

By Michael B. Field, Member, A.M.Inst.C.E.

(*Paper read at Glasgow, May 13th, 1902.*)

(*Continued from page* 801.)

For studying the probable current required along a given route it is convenient to have the tractive effort necessary for propelling a given weight of car up different gradients, and for accelerating, drawn out on the same sheet. As an example, examine fig. 13, drawn out for a 12-ton car as above described. The rolling and journal friction of the car truck have been allowed for in the gradient line. They may, of course, be represented by a small up-grade. Thus this line does not pass through the origin.

In calculating the force necessary to produce a given acceleration it is necessary, not only to consider the lineal acceleration of the car as a whole, but also, the angular acceleration of all rotating parts.

We must, in fact, increase the actual dead weight of the car by a

certain amount when calculating accelerations, to allow for the angular acceleration of motor armatures, wheels, &c.

If w = dead weight of car with all accessories in lbs.

r_1 = radius of gyration of armature shaft with armature, commutator and pinion.

r_2 = radius of gyration of axle, with car wheels and gear wheel.

r = radius of car wheel.

w_1 = weight of armature shaft, armature, commutator and pinion in lbs.

w_2 = weight of axle, two car wheels, and one gear wheel in lbs.

ρ = gear ratio.

T = tractive effort—measured at tread of wheels—per axle, in lbs.

a = acceleration of car in miles per hour per second.

Then for a four-wheel car with two motors—

$$T = 0456 \left\{ \frac{W}{2} a + (w_1 r_1 \rho + w_2 r_2) \frac{a}{r} \right\}.$$

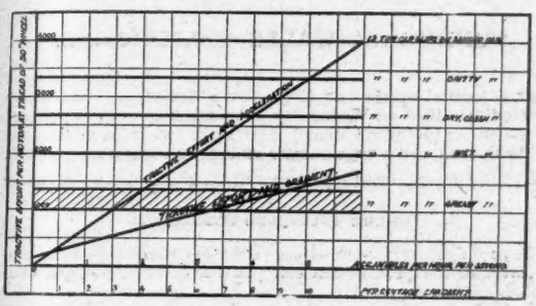


Fig. 13.

Thus for an ordinary case, such as has been assumed, from 9 to 10 per cent. should be added to the dead weight of the car, to allow for the angular acceleration of the rotating parts. This has been allowed for in fig. 13.

Suppose we wish to find the current to accelerate a car up a grade of 5 per cent. 3 miles per hour per second, we see that for the acceleration alone 2,020 lbs. tractive effort is necessary; to this we add 800 lbs. to overcome the grade and friction, obtaining a total of 2,820 lbs.

On greasy rails the wheels would slip, but on sanded rails the car would mount with the desired acceleration with 90 amperes (motors in series).

Having obtained all the characteristic curves relative to the motor, the question at once arises, at what point is the efficiency of most importance to us, that is to say, what shape should the efficiency curve have in order to get the greatest commercial advantage?

This is a most difficult point to settle; it will naturally depend on the nature of the route, hilly or otherwise, amount of traffic, average number of stops per hour, skill of motorman, maximum speed allowed by the Board of Trade, and a large number of other factors. I prefer to divide up the journey into five periods:—(1) current cut off; (2) running with resistance in circuit, motors in series; (3) full series; (4) resistance, with motors in parallel; (5) full parallel.

To show you roughly the proportion of these intervals I have constructed diagram fig. 14, which shows three complete journeys at different times of the day, on different routes, and with different motormen. Time is represented horizontally, and the various intervals, which were carefully observed under normal traffic conditions, blocked in to form a square diagram. These journeys give the following analyses:—

Journey.	Time of day.	Total time.	Total time in seconds for periods.				
		Secs.	1	2	3	4	5
Springburn to Pollokshaws and back	11 a.m.—12.30	5,070	2,756 54·2%	625 12·4%	758 15%	253 5%	678 13·4%
London Road to Whiteinch and back	4 p.m.—4.55, and 3.30—4.20 p.m.	6,415	3,531 54·9%	1,158 18%	1,217 19·2%	105 1·6	404 6·3%
Mount Florida to Maryhill and back	11.45 a.m.—12.5, and 12.5—1 p.m.	6,738	3,600 53·3%	1,124 16·7%	1,507 22·5%	142 2·1%	365 5·4%

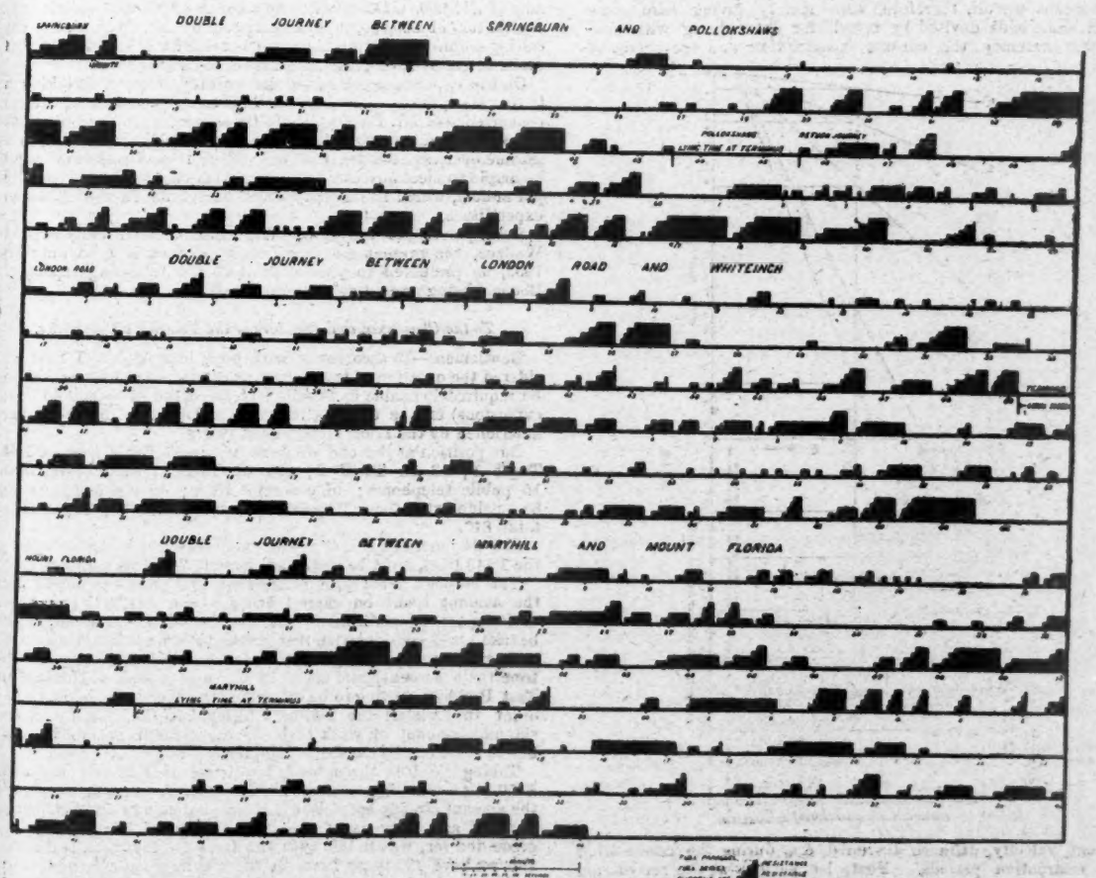

DOUBLE JOURNEY BETWEEN SPRINGBURN AND POLLOKSHAWS
DOUBLE JOURNEY BETWEEN LONDON ROAD AND WHITEINCH
DOUBLE JOURNEY BETWEEN MARYHILL AND MOUNT FLORIDA

Fig. 14.

Suppose that after taking a large number of such tables on different routes, at different times of the day, and with different experienced motormen, we come to the conclusion that the current is cut off for 50 per cent. of the whole time, the series notches are in use during 35 per cent., and the parallel notches during 15 per cent. of the whole time.

Suppose, further, that from readings taken in the power station

we find the average current per car = 15 amperes, then the average current per car taken over the time that the current is actually on will be 30 amperes. We may assume, moreover, that the average current on the parallel notches is twice that on the series notches, which will result in an average current per motor of 23 amperes. In all probability the average current per motor during the time the motors are in full series and in full parallel will be less than this rather than more, since the momentary rushes of current during acceleration on the different controller notches are considerable. At present the average current per car for the Glasgow system is more nearly 12 amperes than 15 amperes, and it is, therefore, from considerations such as these that I am led to the belief that in Glasgow, at any rate, the 250-volt efficiency curve just about the bend is of very great importance, and we should try to have as high an efficiency at this part as possible, even at the expense of a drooping efficiency curve at the higher current values.

This part of the curve is most difficult to obtain accurately, but a large number of points should be taken, so that the true shape of the bend can be studied. There is one point for each motor where the total motor loss will be a minimum. I have shown a "total loss" curve in figs. 3 and 4; in fig. 3 is shown the total loss in kilowatts at 500 and 250 volts, and in fig. 4 total loss in horse-power at 500 volts.

In fig. 4 the line for horse-power input is also drawn to same scale, so that the difference between this and "total loss" curve represents brake horse-power at 500 volts.

It is interesting to compare the current corresponding to minimum loss with the average current per motor.

The writer is convinced that in many cases a considerable economy may be effected by giving due consideration to the manipulation of the controller.

Undoubtedly the most satisfactory way of studying the acceleration, as also the retardation, periods is by means of a recording ammeter actually installed on a car.

My predecessor, Mr. A. E. Le Rossignol, worked with such an apparatus, it being arranged to record not only current, but speed, and the controller notch, simultaneously. This apparatus has been for a long time out of order, so that I am unable to place before you the results of any such tests. I hope, however, before long, that we shall have time to reset-up this apparatus in a practical shape. I will content myself, therefore, with merely giving here some graphical methods devised by myself for determining with considerable accuracy the current consumption and the curves of

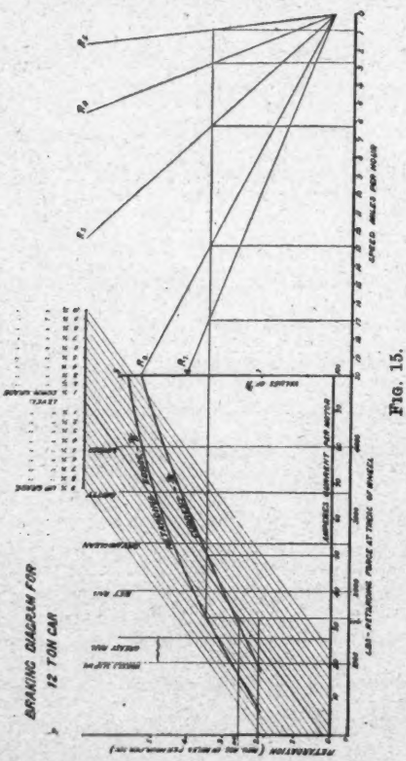


FIG. 15.

current, velocity, distance travelled, &c., during the acceleration and retardation periods. First, let us look at the retardation diagram, fig. 15. Current per motor is plotted horizontally, and to the right-hand side a scale for values of $\frac{n}{R}$ is constructed vertically. Continuing in the same horizontal as the current scale, a reversed speed scale is marked off, and a straight line curve connecting the values of $\frac{n}{R}$ and n is drawn for each value of n, *i.e.*, for the five controller notches. The curve connecting retarding force at the tread of the wheels and $\frac{n}{R}$ is further constructed, the retarding force in pounds being plotted horizontally. Beyond this a number of straight-line curves connecting retardation in miles per hour per second and pounds retarding force per axle for a 12-ton car and a number of different grades have been drawn in. The friction of the car is here represented, for the sake of simplicity, as 1 per cent. up grade.

(To be continued.)

At the meeting of the Glasgow Local Section of the Institution of Electrical Engineers on Tuesday last week, Mr. Henry A. Mavor, the president, delivered his opening address, which was a continuation of a paper on the design of continuous-current dynamos read to the International Engineering Congress, Glasgow, 1901, and which had for its subject the consideration of the design of machines of 20-H.P. and under. A discussion followed in which Mr. M. B. Field and Mr. Arthur Kerr took part, and, on the suggestion of Dr. Maclean and Prof. Gray, further consideration of the subject was adjourned till next meeting.

TUNBRIDGE WELLS TELEPHONES.*

The adjourned special meeting of the Tunbridge Wells Town Council was held on Wednesday last week, under the presidency of the Mayor (Alderman Finch), when there was a full attendance of the Council, and a large number of burgesses were also present.

The following printed report was in the hands of the Council:—

To the Telephone Committee.

In accordance with your wishes we beg to present to you our joint report upon the present financial position of the municipal telephonic undertaking.

In the month of February last, on the occasion of the Corporation's application to the Local Government Board for sanction to a loan of £15,000, making with the amount previously sanctioned a capital sum of £25,000, it was estimated by Mr. Bennett, the consulting engineer, that for this total expenditure of £25,000 there could be constructed 1,148 actual revenue-earning lines.

On the experience gained in the working of the undertaking up to that time, it was estimated by the borough accountant, with the concurrence of Mr. Bennett, that the annual expenditure when the 1,148 lines had been completed would be £4,162, giving a surplus of income over expenditure of £1,086, which it was considered would be ample to meet any contingencies which might arise beyond £135 per annum, which had already been allowed for in the estimate of expenditure.

Subsequently to the Local Government Board inquiry, Mr. Wallace, the present manager, was appointed, and on July 3rd, 1902, he presented to your committee the following report, Mr. Bennett being present at the meeting:—

To the Chairman and Members of the Telephone Committee.

Gentlemen,—In accordance with your instructions, I have considered the question of the amount of capital expenditure that will be required to enable us to complete the 1,148 lines (and 46 inside extensions) for the erection of which a loan of £25,000 has been sanctioned by the Local Government Board.

Our position at the end of June was:—Working lines—234 on Tariff 1; 53 on Tariff 2; 295 on Tariff 3; four free lines; 15 public telephones; nine service lines; 40 inside extensions; 88 outside extensions; 22 private lines; 26 sundries; 24 junctions; total, 810.

The 24 junctions and 40 inside extensions, not being included in the 1,148 lines, must be deducted, leaving 746 working lines.

The borough accountant informs me that up to the end of June the amount spent on capital account was £21,733, but before dividing this expenditure by the number of lines erected, it must be taken into consideration that, owing to bad workmanship on the part of the contractors (and for which a sum of £300 was deducted from their account), and some of the routes, such as Hadlow and East Peckham, having to be erected in the shortest possible time in order to forestall the National Telephone Co., there is a considerable amount of work to be done and additions to be made before these can be classed as completed lines.

Taking the area throughout, I estimate that it will cost about £450 to do what is necessary in this respect. Adding this sum to the amount already spent brings the capital cost to £22,183. Seven hundred and forty-six of the total number of lines having been accounted for, we are left with 402 lines to complete, and against this we have 192 spare lines in the existing underground cables, and a certain amount of spare capacity on the existing poles. So far as the Local Government Board is concerned, we have 192 lines partially completed and 210 new lines to build. To carry out this work we have £2,817 in hand, and instruments, line stores, and tools to the value of some £1,200.

In estimating, however, the probable cost of the lines in question, it is desirable that the following fact should be taken into consideration.

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* Abstract of report from *Tunbridge Wells Gazette*, November 12th, 1902.

1. That, to a very great extent, the people who need telephonic communication most, have their places of business in the centre of the town or villages, and these are the first to give their orders and obtain connection, consequently we have now to go further afield for new orders, and into districts where underground cables have not been laid, or where existing cables are already working to their utmost capacity, consequently the lines cost proportionately more to build.

2. Our underground cables are spread over 44 distributing points, some of which are now without spare wires, and of the 192 spares previously referred to, a number cannot be utilised, owing to wayleave or other difficulties, until they are extended to more suitable districts.

In connection with this matter, you will doubtless recollect that, in Mr. Bennett's evidence at the last inquiry, he stated that when the 1,148 lines were completed, there would be only 40 spare wires in the underground cables. When it is considered that this number has to be divided over 44 distributing points, you will at once see that long before this limit is reached additional cables must be laid, and the extent of the additional underground work will, of course, depend upon whether the new orders are obtained in Tunbridge Wells itself or in the neighbourhood of the village exchanges.

3. The cost of opening out new districts and connecting them by junction lines with a central exchange (however desirable and necessary such a course may be) is an expensive matter, and the amount of money we shall require in the near future will depend to a great extent upon the number of new districts you propose to connect to our present system; for instance, in Mr. Bennett's last estimate it was proposed to erect:—

One junction circuit and 20 subscribers for Lamberhurst at a cost of	£597
One junction circuit and six subscribers for Withyham at a cost of	£269
One junction circuit and six subscribers for Langton at a cost of	£263
One junction circuit and 14 subscribers for Paddock Wood at a cost of	£719
One junction circuit and eight subscribers for Goudhurst at a cost of	£677
One line to Capel Hospital	£75
Instruments for same	£137

or a total of 55 completed lines for £2,737, which works out at £49 15s. per line. In addition to this, an exchange at Speldhurst was previously estimated for at £174 for six subscribers.

Returning to the 402 lines we are expected to provide, I would recommend that as there is very little prospect of a satisfactory revenue being obtained from Lamberhurst, Paddock Wood, or Goudhurst, we should defer the proposed extensions to these villages until we are sure of a fair return from the capital expenditure involved. Withyham, by itself, is a small place, and would not produce much revenue, but when the 13 new orders recently obtained in Hartfield and district are connected thereto, the revenue therefrom, exclusive of tolls, will produce £60, and the cost per line will not greatly exceed the amount allowed for by Mr. Bennett (viz., £45 per line). Providing that you decide to defer the extensions to Lamberhurst, Paddock Wood, and Goudhurst, I estimate the cost of completing the 402 lines, including those at Withyham, Speldhurst, Langton, and Fordcombe, at £25 per line, or £10,050.

This means that with £3,817 available, an additional sum of £7,133 will be required; but when the 1,148 lines are in actual use, we shall have provided for this amount 25 per cent. of spares in our underground cables, a good working margin on our pole routes, and some £1,200 value of instruments, line stores and tools, instead of as mentioned at the last inquiry, less than 3 per cent. of spares, and little or no stock in hand.

I have not included in the above amounts the conversion of the central switchboards into multiple boards, nor the provision of a testboard and cross-connecting frame, the cost of which, to accommodate 1,000 lines, would be (including labour, &c.) approximately £800; nor have I included any extensive structural alterations or exchange removals, but the £25 per line will be sufficient to cover a reasonable number of wayleave alterations and contingencies generally during the construction of the lines in question.

Taking the situation as a whole, it appears to me that the present is a fitting time to decide upon our future policy. On the one hand by applying now, or in a few months' time, for a further loan, we can, if it is sanctioned, increase our underground and aerial capacity in Tunbridge Wells, complete the whole of the unfinished work throughout the area, and extend our system into any suitable districts that may be decided upon.

This is a course which I feel sure commends itself to all interested in the progress of municipal telephony, but before adopting the same, it must be borne in mind that unless we are sure of some 300 or 400 new orders in the immediate future, a few years may elapse ere we can reap the full revenue from the plant we put down.

On the other hand, if it be decided that no further loan is to be applied for, steps must at once be taken to reduce our present expenditure, and the question then arises as to what portion of the work already in hand or sanctioned can be deferred. The following is a list of work in hand:—

Langton Exchange, 1 junction line and 6 village subscribers	£75
Fordcombe Exchange, 1 junction line from Langton and 6 village subscribers	110
Completion of Penshurst junction (tree cutting and regulation)	10
144 pair cable for Molyneux Park and London Road	669
Six distributing poles and aerial construction for 30 lines (Molyneux Park) at £9	350
Capel Hospital	75
Extension of central switchboard to 500 lines	150
Larger switchboards for Tonbridge, Rotherfield and Crowborough	110
Additional cable for Crowborough Exchange, and higher poles at road crossings	60
Outstanding accounts	600
Instruments for the 42 lines above mentioned	136
Seventeen orders in hand (most of which are long-distance lines)	408
Total	£2,748

The balance of work sanctioned comprises:—

One 144 pair cable to Beltring Road with branches	£785
Distributing poles aerial construction for same at £9 per line	1,296
Extension to Lamberhurst, 1 junction and 20 subscribers	597
Extension to Withyham, 1 junction and 13 subscribers	550
Extension to Paddock Wood, 1 junction and 12 subscribers	491
Extension to Speldhurst, 1 junction and 6 subscribers	174
114 partially-completed lines at £9	1,026
81 fully-completed lines at £25	2,025
	£7,671

In addition to the latter a certain amount must be provided for further switchboard extensions, structural alterations and contingencies generally, making the amounts approximately £3,000 for work in hand, and £9,000 for work sanctioned.

By deferring the Molyneux Park cable work and holding over the constructions of any new orders the cost of building which will exceed £12 per line, I can make the £2,817 last for the next 12 months; but this is not a course that is advisable to adopt unless we have no other alternative, especially as it would mean the paying off of three or, perhaps, four gangs of men, and a possible reduction in the instrument department.

I have the honour to remain, gentlemen, your obedient servant,

(Signed) G. S. Wallace.

When this report was considered it was pointed out to the Committee by the town clerk and borough accountant that, in effect, it recommended an application for a further loan of approximately £9,000, made up as follows:—

Required to complete work in hand	£3,000
Cost of work sanctioned by Committee	9,000
	£12,000
Less amount in hand	2,817
	£9,183

The Committee's attention was also drawn to the fact that this £9,000 would comprise work which had actually been included in the estimates and plans placed before the Local Government Board by Mr. Bennett, and which that gentleman had stated would be covered by the £25,000 loan which the Local Government Board had sanctioned.

The work referred to in the last paragraph, none of which has since been done, is as follows:—

Lamberhurst	£597
Withyham	269
Paddock Wood	719
Goudhurst	677
144 pair cable for Molyneux Park	669
Distributing poles and aerial construction—Molyneux Park	1,296
144 pair cable to Beltring Road	785
Distributing poles and aerial construction for same	1,296
Speldhurst	174
	£6,482

After looking into the matter, Mr. Bennett came to the conclusion that he had, in his estimate, inadvertently omitted the whole cost of the aerial lines required to render the Molyneux Park and Beltring Road cables revenue earning, the amount thus omitted being at least £2,500.

The Borough Accountant also reported to the Committee that the average earnings of each line which at the Local Government inquiry had been taken at £4 11s. 5d., was steadily falling, owing, mainly, to the fact that 80 per cent. of the lines then being constructed were unremunerative.

The Town Clerk expressed his opinion to the Committee that, having regard to the position of matters as shown by the investigation which Mr. Wallace had made since his appointment, it would be practically impossible to succeed in obtaining a further loan in face of determined opposition, and that the time appeared to be approaching when the Corporation would have to consider whether they should endeavour to acquire the National Telephone Co.'s undertaking in the Tunbridge Wells area and re-arrange the rate, or dispose of their own system, as it appeared practically certain that it would be a charge upon the ratepayers.

The Committee decided that it was not desirable to publish Mr. Wallace's report, as to do so would simply injure the Corporation undertaking and tend to reduce its value, but they directed Mr. Wallace not to proceed with the Paddock Wood, Goudhurst, or Lamberhurst extensions, or the cable to Molyneux Park, to reduce the gangs of men employed on "capital" work, and to stay any steps with regard to a then contemplated extension of Cousley Wood.

Since Mr. Wallace's report was presented in July last every economy has been practiced, and the connection of fresh subscribers has, as far as possible, been limited to those whose lines would clearly be remunerative. But the time has now arrived when the £25,000 loan has been exhausted, as appears by the following balance-sheet:—

Liabilities.		Assets.	
Proceeds of £28,200 stock	£25,000	Cost of undertaking, including stores	£25,148
Sundry creditors	1,859	Debtors	11
		Cash in hand	1,700
	£28,859		£26,859

At the end of October, 1902, the number of actual revenue earning lines constructed was 853, and by using the stores in hand and reducing them to the value of £600, Mr. Wallace is of opinion that the number of lines can be raised to 883. If, further than this, Mr. Bennett waives the whole of his commission, Mr. Wallace will be able, by carefully selecting the orders, to increase the number of lines to 1,010.

The average rate of earning per line has, however, fallen since February, 1902, from £4 11s. 5d. to £4 2s. 10d. The average cost of construction per line as estimated by Mr. Bennett in February last was £21 15s. 6d.—*i.e.*, 1,148 lines were estimated to cost £25,000. Actual experience has shown that the average cost of construction per line has been £28 6s.—*i.e.*, only 883 lines will have been constructed for £25,000. The diminution in the number of lines from 1,148 to a possible maximum of 1,010, coupled with the reduction in the average annual earning of each line brings about the result that the excess of income over expenditure which was estimated for at the time of the inquiry has disappeared, and the undertaking shows an estimated annual loss of £19 without taking into account any allowance for contingencies.

It appears to us, if we may respectfully submit our views for your consideration, that there are two courses open to the Corporation:—(1) To accept the offer of the National Telephone Co.; or (2) to endeavour to obtain the sanction of the Local Government Board to a further loan of at least £10,000, explaining the position in which the Council is placed, and increasing the rates charged to subscribers—running the risk of a decrease in their number.

It is manifestly impossible for the Council to continue its undertaking unless it can obtain a fresh loan, as after the 1,010 lines had been completed all new subscribers would have to be refused, and no work involving capital expenditure on construction could be undertaken.—We are, Gentlemen, your obedient servants,

W. C. Cripps, Town Clerk.
J. W. Forster, Borough Accountant.
Geo. S. Wallace, Telephone Manager.

The Mayor, at the outset, intimated that at the suggestion of the Town Clerk the Standing Orders would be suspended to enable members of the Council who spoke at the previous meeting to speak again if they wished.

The Town Clerk next read the resolution passed by the Tradesmen's Association the previous evening, which was referred to the Telephone Committee. A memorial was next read from Groombridge residents, objecting to the sale of the undertaking.

A deputation was next received from the Tonbridge Ratepayers' Association.

Councillor Abbott having introduced the deputation,

Mr. Wardley acted as the spokesman.

The deputation asked the Council to seriously pause before committing themselves to a course which would do away with competition. He submitted there was a strong case to make the Council pause, and having paused, they might find ways and means to maintain their present efficient system.

Alderman Putland then introduced a deputation from the meeting of ratepayers.

Dr. Rankin acted as spokesman, and said that the burgesses felt that their future prospects under the control of the National Co. depended not on the promises which they so lavishly made at the moment, but upon their action in the past. It was in consequence of the unsatisfactory service and higher charges that the Corporation, after much trouble, patience and investigation, decided in response to the earnest solicitation of a large number of burgesses to establish a system of their own. This system had worked so well that the burgesses viewed with alarm the possibility of reverting to their former evil plight. The memorial which he had to present, contained, unfortunately, no reference to the information which had been studiously kept back till the eleventh hour, viz, that owing to initial errors in the estimates the financial position of the Corporation was not in that satisfactory position which the burgesses had always been given to believe it was. They could only express their great regret and disappointment that it was so, and that by the withholding of this important information they had been allowed to live in a fool's paradise. If that information had not been withheld the telephone users would have been able to say, with greater effect, what they were now anxious to say, viz., that they would agree even to a substantial increase in rentals rather than find themselves once more in the power of the National Co.

The Town Clerk said he had just received a resolution from the Rotherfield Parish Council, objecting to the proposed sale.

Councillor Strange said he had received a telegram from Mr. Bennett.

The Mayor suggested it should be handed to the Town Clerk, who read it as follows:—

"Bennett, Stock Exchange, Glasgow, to Councillor Strange, Town Hall, Tunbridge Wells.—If my name is brought into discussion, I consider Town Council do me great injustice if they come to any resolution without consulting me. Shall be obliged if you convey this to them."

Councillor Marsh then resumed the debate. They had now before the Council a report, which was presented to the Telephone Committee last July, but not published. He was, unfortunately, unable to be present at the meeting of the Telephone Committee at which that report was presented, but he was at the next meeting, and the gist of it was explained to him. It appeared that they wanted £9,000 to complete the work included in the estimates. They were now told that this work still remained to be done, but assuming that this was so, it was not a peculiarity of telephone estimates. Let them wait a reasonable time, and by giving the undertaking a fair chance, they would find out what their working expenses really would be. They were told they must apply for another £10,000 loan, and that no provision had been made for contingencies, &c., but supposing they added this £10,000 to their capital; they could meet the interest and sinking fund with an average of £5 per subscriber. They were told that, with 1,010 lines they would have a deficit of £19 on the year's working, but calculating at £5 income per line, they would have a surplus. He wished to consider the proposed agreement on its merits. They had no guarantee for the efficiency of the future service. The Town Clerk had told them there was no security.

The Town Clerk read the clause.

Councillor Marsh said the company agreed to render "a proper, efficient and continuous telephone service," but the town clerk had advised them that it was impossible to define an efficient service in an agreement. He knew that in many other towns the service was as bad as it could be. Another point against the agreement was that they had no security that with improvements in telephony they could get a rate below £6. A few years ago a £6 rate would have been laughed at, and who could say that a £2 rate would not be possible in the future? Would Tunbridge Wells have the benefit of such reduction? Then again, as regards the security the Corporation would have, the deferred stock of the National Co. stood at 59. That was a point higher than it was a week ago. He did not know if there was any reason for that advance. Further than that, what would happen when the license of the National Co. expired? He instanced that at Dundee a competitive company was bought out at 40 per cent. premium. Yet they at Tunbridge Wells were selling their undertaking at cost price. His contention was that the agreement wanted further consideration, and that the suggestion to sell was premature. Before any agreement was entered into he wanted a guarantee of an efficient service, and such further reduction in tariff as other towns might obtain. He also wanted a fair price for the undertaking, and the interests of the staff safeguarded.

Councillor Strange thanked the Council for the suspension of the Standing Orders, which enabled him to speak again. From information which had now been drawn up by the borough accountant, it appeared that they were in a grave difficulty. Their new loan was all but exhausted. They found their estimates exceeded, and there was a certainty that there would be a loss, which would fall on the rates. The Town Clerk told them that this being the position, he did not feel able to carry on the undertaking, and he hoped they would not think him discourteous in certain steps he had felt it necessary to take. Not only had the Committee never considered that proposal, but he had no reason to believe that such steps were contemplated. The Town Clerk laid himself open to the charge that he was afraid to give the Committee time to consider the agreement, and therefore attempted to get it through quickly, and consequently this had the result of raising throughout the country a feeling of resentment and alarm for the purity of local government. They were asked to capitulate to the enemy without an opportunity of considering the terms of surrender. He felt there must be some alternative to surrender. They must not sell in haste to repent at leisure. There was no doubt the National Co. knew as much about their undertaking as they did, and if they were willing to buy the undertaking, it was worth keeping. They knew the worst now, and they could raise their charges to prevent a loss to the rates. What were the charges made against their undertaking? They were told that their engineer had made a mistake, but it was only fair to him to say that directly his mistake was pointed out to him, he did what an honourable man would do. He offered to pay for his mistake. He offered to forego his commission, and make up any deficit incurred by his miscalculation.

Councillor Rule: That is absolutely wrong.

Councillor Strange: I have the telegram here.

Councillor Rule: Read it, then. All I can say is that it has not been before the Committee.

Councillor Strange said that the telegram simply said you can do as you suggest, and referred to a telegram which Mr. Bennett had sent to Mr. Nicholson. Mr. Nicholson now telegraphed to him, and claimed that before he was judged he should have an opportunity of replying. He was willing to enter into an undertaking to pay any deficit, which could be brought home to any miscalculation on his part.

Mr. A. Nicholson: Up to 1,000 lines.

Councillor Rule: What about the rest of the lines in the estimate?

Councillor Strange said that whereas it was estimated that they would have 1,148 lines for £25,000, they had only got 1,010 owing to a mistake in the estimates. They had also made a mistake in estimating their revenue at more than it proved to be. Instead of averaging £4 11s. 5d., it had worked out at £4. This was capable of explanation, because the £2 10s. tariff had proved a failure. It had not realised the estimate based upon it. People recollected that every time they used their telephone it would cost them a penny, and they were careful about using it, and did not take the full advantage of it, but it was a fact that the longer a telephone was in the house, the more it was used. Why not go to their subscribers, and tell them that a mistake had been made, and the tariff must be raised. These mistakes were depressing, but they did not affect the principle. It did not prove that municipal telephony was not right in principle, because the estimates had been inaccurate. All over the country competitive systems were being started. Under their new manager, the Exchange was now working smoothly, and they would avoid past mistakes. He considered they were behaving very unfairly to their new manager, whom they had brought from a long distance. He hoped the Council would not allow telephony to come again under the paralysing grip of a great monopoly. Their subscribers would willingly pay £1 or £2, or even £10 a year more.

Councillor Beale: Rubbish!

Councillor Strange said he had been informed so. He wished to urge that the Council would give up their streets to the National Co., after fighting two actions at law to prevent them from doing what they would now do. They would pay 2s. 6d. per subscriber for the privilege, but at Manchester they paid 5s. If he accepted the resolution of Mr. Stone, he considered he should be

submitting to an act of craven folly, and his successors would reproach his memory. He was willing to take whatever responsibility attached to him as a member of the Committee for the fact that the estimates given them had been exceeded. But they were now getting over their difficulties, and they would soon no longer stand alone, because other Corporations were taking the matter up. In undertaking the work they had the direct mandate of the burgesses. If they succumbed to the first obstacle it would be to their everlasting disgrace. Mr. Strange moved that the joint report be referred to the Telephone Committee for farther full report for the most desirable course to be pursued.

The Mayor pointed out that an amendment could be moved for an adjournment of the debate, but it must take place before the 22nd.

Councillor Smith said they were all agreed that it was a most important question. The report came to him as a great surprise. They had heard a great deal during the last week about secret negotiations. What was there to be said on behalf of the Telephone Committee, who, in the words of the report presented to them by the manager of the Telephone Committee, knew, as far back as last July, of the serious state of affairs? The Committee had never had the courtesy or consideration to invite the members of the Town Council, who were partners in the undertaking, but left them under the impression that that undertaking was a paying concern. The Committee decided not to make the matter public, as they thought it would not be desirable, and would injure the undertaking. But he considered that the Council should have had the right to take part in a discussion of such an important question as that. The Council should have been acquainted with the grave state of affairs, which had been known to the Telephone Committee since July last. A great deal had been said about the subscribers promising to pay more. Did that appeal to them as a businesslike transaction? Did it appeal to them to receive private subscriptions, as had been mentioned that morning? He thought it out of the question; they were to carry on the undertaking to the best of their ability, and save a charge upon the rates, and they could not appeal to public sentiment. What would they say to a tradesman who, when he found his business was not paying, asked his customers to kindly pay him so much more money for his articles? As men of business, they had to view that matter, and what were the prospects? At the inquiry when the town asked for a loan of £15,000, the estimated receipts were £5,248; viz., 1,148 lines at £4 11s. 5d. What were the results? In October, 1902, the number of actual revenue earning lines was 850, and by using stores, Mr. Wallace was of the opinion that the number of lines could be raised to 883. They had spent all the money, and only had 883 lines, and the income came to £3,652, and they had a loss of something like £400. But Mr. Wallace also said that he would have to apply for another £10,000, because that money was all gone. A good deal had been said about sentiment; he was there to represent the burgesses who returned him. He did not forget that the telephone users in the question were entitled to consideration, and the agreement did assist the telephone users. It guaranteed an unlimited service at a fair rate. He thought the figures had proved that telephony could not be carried on so cheaply as some people had imagined. He did not mind the country laughing at them so long as the ratepayers did not pay. The country might laugh, but would not pay the rates, and he did not see why the Council should make costly experiments for the benefit of the country. In the face of the figures they would be incurring a grave responsibility to continue with the undertaking.

Councillor Barton spoke in favour of the sale of the undertaking.

At some length, Dr. Abbott argued against the transfer of the concern, dwelling in the course of his plea upon the undue haste and misunderstanding attending the question.

Councillor Edwards attributed the unfortunate position in which they found themselves to the remissness of the Telephone Committee in adopting the advice of its manager, Mr. Wallace, contained in his report of admonition to the Committee, and to the Committee not having exercised that due caution over their telephone business that tradesmen would show over private businesses. Even if it did become a charge upon the rates, it meant, at the rate of £300 a year, less than a ¼d. rate.

A Councillor: Where does the sinking fund come in?

Councillor Edwards replied that the sinking fund and interest had been accounted for. Were the Council going to sell a benefiting undertaking for the paltry sum of a ¼d. rate? He would venture to say that no one in the borough, from the poorest to the richest, would refuse to pay that ¼d. rate. In his opinion, it would be wise if the Telephone Committee were re-constructed with practical, and not theoretical, men of business. A couple of scares had been provided them, upon which the broad light of day had not shone. Had the report of the Telephone Committee been placed upon the agenda, the Council would have had the right to discuss that very amendment.

Councillor Hicks reminded the meeting that the Council could not borrow money now at 3 per cent., and if money were borrowed, it would be necessary to have a sinking fund in order to repay the amount. Many of the figures given to them were valueless. For months prior to his intention of contesting for municipal honours he had interested himself in the undertaking of municipal telephony. He had carefully read the evidence adduced at the local inquiry, and the conclusion he had come to was that each of the estimates would be falsified, and the figures proved incorrect. Without alluding to personalities, he would say that the time had come to expose things. A great deal had been said against the National Telephone Co. As he had stated in public, he did not hold any brief for that company. They had said that the rates of the National Telephone Co. were high. Who first cut the rates? They did. The N.T.C. had a right to cut their rates. The public had nothing to complain of. The way their undertaking had been carried on had been a bolstered-up affair from a financial standpoint. There had been large charges of interest, which had fallen upon the rates. The money had not been borrowed for nothing; a large amount of interest had to be paid by someone, as he noted from the figures. The annual cost of telephony at the time they had utilised the National service was £160. To-day the cost was £271 per annum. He was positive that the municipal telephone had been put in almost every conceivable place. It was gross and scandalous, and an attempt had been made by the Council to bolster-up its own undertaking, by giving these facilities. The crux of the whole position was that the Municipal Telephone Committee was to blame. He would wish to give other members of that Committee a chance of answering that. The report was the worst he had ever read. He referred to the one presented to the Committee on July 3rd. As far as they were aware, the Committee had done nothing as the result of that report. Instead, it appeared to have allowed matters to drift, trusting in Providence that it would come right. Not one meeting of the Telephone Committee had been held since last Wednesday's special meeting of the Council, and it was only since his election to that Committee that a meeting had been convened. It was not a business-like way to do work. A member of the Committee admitted that he had not seen or read of that particular report. It had been told him that the Committee, to a large extent, was a one man committee; and it had been asked, "Why don't they consult their chairman?" It was a well-known fact that the late chairman of the Telephone Committee was a telephone fanatic. He would say that the two respected gentlemen—Alderman Stone and Mr. Cripps—conducting the negotiations for the proposed transfer, had done the right thing in the wrong way. Still, he was in sympathy with them. Their bringing it before the Council in the way they had was the only possible mistake they had made. The opinions yellingly expressed at the protest meetings had been the outcome of ignorance; and he deprecated the idea of people getting up to speak at public meetings upon subjects of which they were ignorant. Judging by the speeches made that morning, he was of the opinion that the councillors who had spoken had profitably utilised the leisure time since last Wednesday. The expense for six months, based upon facts, was £1,514. Had it been their experience that any single company had charged to revenue account that which could be charged to capital account? He did not think so. The annual expenditure was £3,918. He must protest against digression in favour of any estimates in the future. Over £1,000 was necessary for depreciation. He deprecated what Mr. Edwards had said if his figures were incorrect.

Mr. Edwards: I am quite willing to assume that the rates would be a halfpenny, and not a farthing.

Continuing, Councillor Hicks said a penny rate meant £1,000. It was no use gentlemen, knowing nothing about it, saying it was not a colossal loss. The estimate of £19 was fallacious, in so far as the result was concerned, inasmuch as it was based on securing new subscribers out of money which Mr. Bennett was going to refund to the Corporation. He would protest against accepting any money from Mr. Bennett. If deserving, then take it from him and let him go. Councillor Strange was unfortunate in alluding to Mr. Bennett, as he had certain details which, if read, would make Councillor Strange regret he had introduced the name of Mr. Bennett. Eliminating the subscribers, they had a further loss of over £500, and there was a loss of £1,600 on the new estimates. The Tonbridge deputation had practically said that if they intended to give them a nice telephone service at a loss to the ratepayers, they would be pleased. From what he had seen of the protest meeting, he was inclined to think that certain medical gentlemen had stepped in where angels feared to tread. A lot of the remarks were simply socialism, and he hoped in the reply sent to the letter received from Hull, that it would be stated that he (Councillor Hicks) thought it was a gross impertinence that they should be compared to Tammany, or any other body bearing such an opprobrium. In the eyes of the commercial world the undertaking was discredited. They desired it to be a business rather than a philanthropic undertaking. He had convinced himself that the undertaking must, and would, entail a very heavy loss upon the rates of the town. He would, therefore, vote for the sale of the municipal telephone service to the National Telephone Co. He considered the position critical when, at a meeting of the Telephone Committee on the previous day, it was stated there was not sufficient money to pay the wages on Saturday unless the stores were sold.

The borough accountant dispelled the idea of Councillor Edwards that there was cash in hand to the extent of £1,700. In reality the situation was that there was a deficiency of £159.

Alderman Delves said all the members of the Committee, with the exception of Councillor Marsh, were present at the meeting in July, when the report was presented. He considered the users would have all they wanted if the agreement was adopted. He believed that the Town Clerk and Alderman Stone had the interests of the town at heart, and they had succeeded in getting a good agreement out of the company.

Alderman Stone having replied on the whole debate in an able speech, the resolution was carried by 19 to 8.

Mr. A. R. Bennett has written to the *Daily Chronicle* (November 18th) under the heading "The Alleged Deficit," as follows:—

I have, in consultation with the Protest Committee, looked closely into the alleged deficit in the telephone department's accounts, and find that it is a myth. After paying all statutory obligations for interest and sinking fund, it seems clear that the revenue (which is always improving) for the current year (ending March 31st, 1903) will cover all working expenses. The expected loss of £19 referred to in the panic report turns out to be a forecast for the year ending March 31st, 1904!

It is true that no depreciation is included in the reckoning, but no depreciation is allowed for in the accounts of the Tunbridge Wells Corporation electricity department, which has been in operation seven or eight years. If that is a reasonable and defensible arrangement (and I do not say that it is not, since I am informed that it was recommended by Sir William Preece), why should the telephone department be saddled in the first year of its existence with depreciation amounting to £1,086, as proposed by Mr. Hicks, of the Stock Exchange? Under the license, the telephone department has a purchaser provided for its system when its term runs out, and is consequently in a much stronger position than the electricity department. Yet because somebody thinks that £19 may possibly be lost during 1904, the telephone system must be thrown into its rival's arms at an inadequate price, and without proper security for payment.

I am, sir, yours, &c.,
A. R. Bennett.

A deputation from the Tunbridge Wells Telephone Protest Committee was to wait upon the Postmaster-General yesterday (Thursday), and in the afternoon the members were to hold a conference at the Cannon Street Hotel with representatives of various Borough Councils from different parts of the country, and representatives of the National Chamber of Trade.

The Postmaster-General some days ago intimated to the Tunbridge Wells Corporation that the proposed sale of the telephone system involved so many important points that require the fullest investigation and consideration that he will be unable to decide whether he can, or cannot, consent to the license being transferred, before the date mentioned in the proposed agreement—November 22nd. Therefore, unless the Corporation can secure an extension of time from the National Telephone Co., the sale of the undertaking cannot take place. The Town Clerk has been conferring with the National Telephone Co. as to an extension of time.

ELECTRIC TRAMWAYS.

By C. HOPKINSON, M.I.C.E., B. HOPKINSON and E. TALBOT, M.I.C.E.

(*Abstract of Paper Read before the Institution of Civil Engineers, November 11th*, 1902.)

The authors' experience had been gained principally in the construction of the tramway systems of Leeds and Newcastle-on-Tyne, and the paper discussed a number of important points in tramway practice, which were illustrated by reference to these two systems of tramways.

The nature of the load on a tramway generating station was discussed, and it was shown from actual records to what extent increasing the number of cars resulted in making the load more uniform. With 70 cars or more, the load was so nearly constant that the steam-consumption per unit was substantially the same as though it were constant and equal to the mean. Hence in a station of this size, equalisation of the load by means of a storage battery was of no use as regarded economy, though in a small station it might be of great value. A storage battery equal to replacing one-third of the generating plant for half hour, should, however, be installed in a continuous-current power station for the purpose of replacing a generating unit in case of breakdown, and for running cars at night. The effect of short circuits on the generator was considered; in the worst case there might be a force equal to three or more times the normal force applied at the periphery of the armature for a period of $\frac{1}{10}$ of a second, that being the time which a circuit breaker took to open. This necessitated a very strong connection between armature and fly-wheel. Another effect of the opening of the circuit breaker was the sudden diminution of the load on the engine to nothing, which necessitated special arrangements for preventing the engine from running away. This required either very quick governing or a heavy fly-wheel. Except for short circuits, an ordinary governor and an ordinary fly-wheel were sufficient. Tachograph records showing the rise of speed on one of the Newcastle engines when the load was thrown off were discussed. The question of over-compounding dynamos was considered; and dynamos wound for constant pressure were recommended.

The simplest method of transmitting the power to the cars was to make the trolley wire into an electrically continuous network and to feed the current into it at various points. In practice, however, it was found necessary to divide the trolley line into sections insulated from each other, each section being fed at one point. The points of division in the centre of a city were determined by considerations of safety; in the outer districts, questions of economy and the necessity of keeping the variations of line pressure within limits might come in. The principles were illustrated by reference to Newcastle-on-Tyne. There was no objection to the line pressure occasionally dropping 100 volts below normal; and this led to the result that a 2½-minute service of cars could be worked up to a distance of 2 miles from a feeding point. The most economical size of cable was next considered; the mean current density should rarely exceed 300 amperes to the square inch. This entailed a mean drop of pressure of about 13 volts per mile of feeder, and feeders could be carried to a distance of 1 mile or 1½ miles without boosting. The loss in the trolley wire in supplying 10 cars on 1 mile of double track from one end was between 2 per cent. and 4 per cent. of the power given to the cars. The conclusion was that on the outer sections the line might be divided into sections 2 miles long. In many cases excessive traffic on a particular route had to be dealt with on a few days of the year, the traffic being small on other days. This was illustrated by reference to a case in Leeds where 50 cars had to be supplied with current on 20 days in the year at an average distance of 3½ miles from the generating station. The method by which this was done with continuous current and boosters was discussed, and was compared with and found preferable to three-phase high tension transmission and conversion. The Leeds tramway system was as extensive a system as could be economically served by a single continuous current generating station placed in the centre of the system.

The most important requirements in a motor car for use in city tramway systems were that it should be capable of rapid and well-sustained acceleration, and that it should be able to go quickly up-hill. These requirements could be fulfilled only by motors capable of travelling on the level at speeds far above what was allowable in practice. Curves were given showing the acceleration of the car from rest with various motors and under various conditions. A mean acceleration of 3 ft. per second per second up to a speed of 10 ft. per second could be obtained with motors of a type found to be satisfactory in Leeds and Newcastle. The effect of bad driving on starting was considered.

There was much difference of opinion on the subject of earth returns. In Great Britain the Board of Trade restriction of the rail drop to 7 volts had made cases of electrolysis by return currents very rare, but it could not yet be said that absolute safety was secured for metallic pipes in the neighbourhood of tramway tracks. The resistance of the rails and bonds used in tramway practice, as determined in experiments by the authors, was given. In a new fished and bonded joint, a good deal of current went through the fish-plates and sole-plates. The Falk cast-welded joint was described, and also the thermit-welded joint. It was unadvisable to use such joints on sharp curves or on crossing a bridge with steep approaches, on account of the effect of expansion and contraction. On straight track, however, the lateral support to the rails prevented variations of temperature from doing damage. Experiments were described from which it appeared that from one-sixth to one-fourth of the current in the rails was diverted into the earth. A service of about 10 cars per double mile could be worked over a distance of two miles, the feeding point being at one end, without the 7-volt limit being exceeded. The system of return feeders in Newcastle and Leeds were described. Where the Board of Trade limit was exceeded, if all the current were taken out of the rails close to the power station, the extension of the return feeder to points about ½-mile distant from the power station would produce a very marked reduction in the rail-drop, owing to the fact that the great concentration of current which took place in the centre of the city with converging routes was thereby avoided. This was the system now adopted in Newcastle-on-Tyne, but provision had been made on the switchboard whereby the cars could be divided into two groups, each group being run by its own generator. The first comprised all the cars outside a radius of three miles, and the second all within that radius. In Leeds the greater part of the current would be taken out of the rails close to the power station, but a portion sufficient to bring the drop of pressure in the rails within the legal limit would be sucked back through a number of return feeders about 1 mile long. Exceptional traffics at particular points were dealt with by special boosters and return feeders. The authors' experiments showed that a current of 300 amperes in the rails between two points, 2 miles apart, implied a potential difference of about five volts between those two points. The pressure was proportional to the current within 1 per cent., which showed that the conduction of the leakage current through the earth was metallic in its nature and not electrolytic to any considerable extent. Examination of the current in the rails and of the pressure at various points of the tramway system with a constant current of 300 amperes passing had shown that only a very small portion of the current got into the gas pipes. This result was discussed and was shown to be not surprising. The possibility of electrolysis with such currents as did get into the pipes was considered. Unless there were strata of such small extent and high conductivity compared with the average, and so placed as to cause a concentration of the current into the pipe to a density of a thousand times the mean current density or more, no corrosion of the pipe would take place, and the 7-volt limit might be exceeded many times without damage to the pipe. On the other hand, if such strata were present, electrolysis (with damage to the pipe) was quite possible even though the 7-volt limit was not exceeded.

THE MUNICIPAL TRADING QUESTION IN AMERICA.

According to an article in a recent number of *Cassier's Magazine*, the electrical industries in the United States are uneasy about the movement in favour of municipal ownership of the telephone, electric lighting, &c., which are called "public utilities."

The advocates of the Socialistic system use similar arguments to those we are familiar with in this country, claiming that the various plants can be operated by the municipalities at a cost of from 25 to 50 per cent. less than is charged by private owners, and with a view to obtaining accurate information, there is a demand for a more uniform method of preparing reports relative to the actual expenses of operation and maintenance, and it is urged that a reserve fund should be provided to meet depreciation in the value of the assets of a plant, due to improvements of the art.

In America the question of depreciation appears to be a more serious one than it is here, for it is alleged that it frequently amounts to 100 *per cent. of the value in a single year.*

For the information of the American public, the United States Consul at Liverpool (Mr. James Boyle), prepared a report upon

some of the features of Municipal Socialism in Great Britain, which it is interesting to study, and "see ourselves as others see us."

The writer points out the difficulty in drawing the line as to the proper sphere of municipal socialism. The claim that municipalities are justified in providing "public necessities," or, as they sometimes call them, "public utilities," is defined as undertakings essentially public or semi-public in their functions, which are more or less monopolies.

The British Government has, it is contended, entered upon the domain of "National socialism" by owning the telegraph system and by its proposed gradual absorption of the telephones and the movement in favour of nationalising the railways and the coal supply, &c.

The article alludes to numerous instances of the growth of municipal trading in England, such as the Turkish Baths at Leamington and Harrogate, the water supply, and tramways of Glasgow and Liverpool, the shares in the Ship Canal held by the Corporation of Manchester, the purchase of the Alexandra Palace by North Metropolitan municipal authorities, the rabbit warren at Torquay, the oyster fishery at Colchester, sterilised milk at St. Helens, the Hull Crematorium, the municipal racecourses at Doncaster and Chester, the golf courses at Bournemouth, the stone-flag factory at West Ham, the Municipal Hotels at Bradford and Liverpool, the Bristol Docks, &c., &c.

It will be seen that in this enumeration there is a confusion of ideas between municipal trading and Socialism and municipal enterprise, which is quite another matter. All that tends to the improvement of the towns, such as the provision of public baths, parks, museums, schools of art, golf and racecourses, and everything calculated to increase the attractiveness of the locality belong to municipal enterprise as distinct from trading; and everything tending to promote improved health, such as the demolition of slums and the better housing of the very poor, are essentially undertakings within the legitimate province of a municipality; but the provision of electricity cannot be classed among the legitimate duties of local authorities any more than the supply of such absolute "utilities" as bread, meat, and clothing, which should be left in the hands of the private trader.

Mr. Boyle considers the "housing question" as the one great predominating question in connection with municipal Socialism, and considers it as a heritage of former social and economic conditions, as well as of feudal land laws and past indifference on the part of municipalities, Parliament, and even of philanthropists, the compensation to the owners of insanitary property being one great difficulty in solving the problem; but Mr. Boyle does not deal with the real crux of the question, viz, the removal of the industrial populations to the rural districts, by the establishment of manufactories away from the congested towns, which the development of electricity supply so greatly facilitates.

Mr. Boyle refers to two schools of thought among municipal socialists, viz., those who not only advocate the municipalisation of water-works, street railways, electric lighting and power supply, but who favour the public control of all departments of human production and energy, and the abolition of the private manufacturer, trader, or tradesman.

Mr. Boyle winds up his interesting paper by complimenting the municipal government in Great Britain as being honest, intelligent, and energetic; and, as a rule, he thinks that politics has but little to do with the engagement or retention of civic employés.

Unfortunately, politics enter far too much into English municipal life.

ELECTRIC SHOCK FATALITY.

On Wednesday, November 12th, Dr. G. Danford Thomas, held an inquiry at the Marylebone Coroner's Court into the circumstances attending the death of Evan S. J. Withers, aged 26 years, a fitter employed at the Metropolitan Electric Supply Co.'s works, South Street, Manchester Square, who was killed by receiving an electric shock whilst at work on the 10th inst. Mr. Bamford, solicitor, watched the case on behalf of the Metropolitan Electric Light Supply Co., whilst Mr. G. S. Ram, one of H.M. Inspectors of Factories (electrical department), watched the proceedings on behalf of the Home Office authorities.

Deceased's father said that Withers had never complained of heart affection.

William Norman, a fitter's labourer, stated that on Monday evening he and deceased had to lay some copper strips down in the subways situated in the basement of the works. Witness and another man were in the subway to receive the copper strips from the deceased, who was in the engine room, and whose duty it was to pass the copper strips down through an opening in the floor. The copper strips were between 20 and 30 ft. long, and ¼th of an in. thick; they were like strips of ribbon. They had received down some 16 of these strips when Withers called out, and in looking round he saw his mate getting up off the floor, after having received a shock. He then saw that sparks were on the strips that had been laid down in the trench, and called out that they were "alive." He looked upwards and saw that the deceased was on the ladder leading to the engine room, and he had hold of a post. Witness shouted out to him not to come down, because the place was "alive." Deceased's foot seemed to be slipping from under him, and the current was at once cut off. Deceased fell off the ladder into the subway, and when he went to him he found that he was insensible. Medical aid was at once called in, but he died in about five minutes. The accident was caused through the copper strip cutting the rubber around one of the mains as it was passed down; the wire came into contact with the "live" main.

Mr. Reginald Todd, chief engineer of the company, stated that, in letting down one of the copper strips, it had been allowed to catch and cut the india-rubber that covered one of the mains, and the current being on, the copper strips became charged, and also the post that deceased had hold of, and thus it was that he received the shock. It was evident that sufficient care was not taken in the lowering of the copper strips. The Coroner asked whether it was not usual to protect the mains other than by india-rubber. Did they not have them enclosed in a wooden box? Mr. Todd said that it was not so enclosed. The mains were those which supplied their customers, and were perfectly safe if the india-rubber were not cut. After this experience, however, of course further measures would be adopted to protect them. The men were fully aware the mains were alive, because the current was continuously on. The copper strip would easily cut the india-rubber in going down, because it had a sharp edge to it. There was a clean cut, just as if it had been done with a knife.

Mr. Arthur Wyatt, electrical engineer, superintendent of South Street works, said that the deceased had been working there for six months, and was an experienced workman. After the accident efforts to restore animation were resorted to, and Dr. Simpson was called, but Withers died very quickly.

Mr. Withers, father of the deceased, said that his son was fully aware of the dangers of electrical works, because previously he had worked with witness at the Leyton Electric Works.

Mr. Wyatt, in reply to questions, said that at the time there was not considered to be any danger connected with the work, but in future other means would be taken by way of protection. There was nothing to prevent deceased from looking down the opening so as to see that the copper strip went down straight and did not touch the live mains.

Dr. J. P. Simpson stated that he found deceased insensible, and endeavours were being made to restore animation. Deceased gave a few gasps and expired. Death was due to asphyxia, following an electric shock.

The Coroner said that no doubt the company would see that every protection was provided in future to prevent a similar occurrence. The jury returned a verdict of "Accidental Death," and added a rider recommending that the company should in future see that the mains were more effectually protected.

NEW PATENTS, 1902.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

23,933. "Improvements in supports or hangers for overhead electric wires." T. P. Bentley. November 3rd.

23,941. "An automatic switch for motor bicycles and other motor vehicles." R. H. Walter. November 3rd.

23,949. "Improvements in electrical influence machines." A. Eckstein and H. J. Coates. November 3rd.

23,951. "Protection for electrical conductors or live rails, applicable to railways or tramways." T. Aston. November 3rd.

23,952. "A double wall-plug for electric lighting." H. Hubbard. November 3rd.

23,969. "Improvements in projectors for alternating-current lamps." A. Engelsmann. November 3rd. (Complete.)

23,971. "Improvements in or relating to electric motors." O. H. Pieper. November 3rd. (Complete.)

24,013. "Improvements in and relating to the attachment of carbon filaments and incandescent electric lamps." F. Farta and P. E. Butler. November 3rd.

24,031. "Improvements in and relating to electric cars." T. T. Hindle. November 4th.

24,033. "Improvements in oiling vertical electric motors, which are worked intermittently as in the case of driving centrifugal machines direct by an electric motor." J. W. Macfarlane. (Of the firm of Watson, Laidlaw & Co.) November 4th.

24,035. "Mica insulated cable." W. C. Johnson and S. Paterson. November 4th.

24,068. "Improvements relating to arc lamps." A. De Puydt. (Date applied for under Patents Act, 1901, June 10th, 1902, being date of application in Belgium.) November 4th. (Complete.)

24,075. "Improvements in and relating to conduct wires for overhead electric tramways." J. Whitehead and H. J. Whitehead. November 4th.

24,080. "Improvements in electric switch lampholders." P. J. S. Tiddeman. November 4th.

24,099. "Improvements in or relating to alternating-current generators." H. H. Lake. (The General Electric Co., United States.) November 4th. (Complete.)

24,100. "Improvements in and connected with electric brakes." H. H. Lake. (The General Electric Co., United States.) November 4th. (Complete.)

24,101. "Improvements in methods of and apparatus for transforming electric energy." E. A. Carolan. (The General Electric Co., United States.) November 4th.

24,104. "Improvements connected with trolley wires for electric trams and the like." A. E. Le Rossignol. November 4th.

24,109. "Improvements in regulators for arc light systems." H. H. Lake. (General Incandescent Arc Light Co., United States.) November 4th. (Complete.)

24,111. "Improved method of and means for reflecting electric light especially suitable for shop window illumination applicable also for other uses." THE ALLIANCE ELECTRICAL CO., LD., and W. GILLHAM. November 4th.

24,112. "Improvements in or relating to alternate-current traction systems." W. M. MORDEY and A. G. HANSARD. November 4th.

24,122. "A new and improved arc lamp." P. H. F. SPIES and C. B. TUTT. November 4th.

24,128. "Improvements in electric motors, the invention being applicable to electric fans." A. B. HOLSON. (Date applied for under Patents Act, 1901, November 4th, 1901, being date of application in the United States.) November 4th. (Complete.)

24,129. "Improvements in dynamo-electric machinery." M. MCLAREN. November 4th.

24,148. "Improvements connected with electric fuses." W. B. ESSON. November 4th.

24,149. "Improvements connected with electric fuses." W. B. ESSON. November 4th.

24,172. "Improved system of electric traction." J. GALLOWAY. November 5th.

24,192. "Improvements in and connected with the trolley collectors, trolley poles, and trolley standards employed in overhead systems of electrical traction." W. E. ROWLANDS. November 5th.

24,205. "Improvements in switch lampholders for incandescent electric lamps and the like." J. HEWETT. November 5th.

24,212. "Improvements in brush-holders for dynamo-electric machines." E. A. CAROLAN. (The General Electric Co., United States.) November 5th.

24,220. "Improvements in connections for electric conducting wires." W. PETO and T. O. KENT. November 5th.

24,238. "Improvements in telephone systems." A. EKSTRÖM. November 5th.

24,247. "Improvements relating to electric switches." C. B. AUEL and M. A. MCLEAN. November 5th.

24,260. "Improvements in or relating to trolleys for electric railways with overhead conductors." E. LIMAUGE. November 5th.

24,325. "Improved apparatus for testing the efficiency of electric lamps." R. P. WILSON and G. G. M. HARDINGHAM. November 6th.

24,328. "Improvements in electric incandescent lamps." F. E. W. BOWEN. November th.

24,330. "Improvements in apparatus for the generation and application of electric currents for electrolysis." F. E. ELMORE. November 6th.

24,331. "Improvements relating to electrolytic cells." P. A. GUYE. November 6th.

24,361. "Improvements in and connected with electricity meters." E. SCHATTNER. November 6th.

24,374. "Improvements in and relating to electromotors." J. MACLEAN and H. L. GALLOWAY. November 7th.

24,383. "An improved device for use in connection with electrical contacts." M. SUTHERLAND and E. MARCUSON. November 7th.

24,410. "Improvements in and connected with electrically energised pendulum clocks." G. D. GRANGER. November 7th.

24,419. "Improvements in insulated electrical conductors." J. P. HOOPER. November 7th.

24,455. "Improvements in controlling devices for electric motors, applicable to the motors of elevators and the like." WAYGOOD & OTIS, LTD. (Otis Elevator Co., Incorporated, United States.) November 7th. (Complete.)

24,457. "Improvements in current collectors for trackless electrical cars with overhead conductor." H. J. HADDAN. (Dr. Wiesengrund, Germany.) November 7th.

24,459. "Automatic electrical cut-out." D. R. BRUCE. November 7th. (Complete.)

24,462. "Improved manufacture of cores for arc lamp electrodes." C. D. ABEL. (Gebruder Siemens & Co., Germany.) November 7th.

24,477. "Improvements in means for coupling metallic cores, cables and the like." H. SIDEBOTTOM. November 8th.

24,478. "Improved central exchange telephone systems." B. BRANDER. November 8th.

24,498. "An improvement in the construction of pendant, bracket and standard fittings and globes for gas and electric lighting." T. FORD and F. FORD. November 8th.

24,511. "The guard for an electric tramcar." T. W. WILSON. November 8th.

24,517. "A new and original method of constructing electrical heating and cooking apparatus, and resistances for general electrical work." M. HANKIN. November 8th.

24,531. "A new and improved 'detector' or appliance for use in testing for electric currents." C. OLIVER. November 8th.

24,538. "Improvements in prepayment electricity meters." F. J. BEAUMONT. November 8th.

PUBLISHED SPECIFICATIONS, 1900.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

21,838. "Improvements in apparatus for obtaining direct electrical impulses or currents from alternating electric sources." G. B. Batten. Dated December 3rd, 1900.

21,861. "Improvements in controlling electric boosters." British Thomson-Houston Co. (E. M. Hewlett, New York, U.S.A.) Dated December 3rd, 1900.

21,862. "Improvements in methods of securing pole-pieces to electric machines." British Thomson-Houston Co. (H. G. Reist, N.Y., U.S.A.) Dated December 3rd, 1900.

21,880. "Improvements in or relating to electrical governing or controlling apparatus." E. F. Moy and P. H. Bastie. Dated December 3rd, 1900.

21,886. "Improvements in electrical storage batteries or accumulators." L. E. Lacroix. Dated December 3rd, 1900.

21,903. "Improved means for holding the inner glass and lower carbon of an electric arc lamp." F. J. Green. Dated December 3rd, 1900.

21,904. "An arrangement of electrical resistance especially adapted for electric arc lamps." F. J. Green. Dated December 3rd, 1900.

21,909. "Improvements in and connected with wireless telegraphy." A. E. Blondel. (Date applied for under Sec. 103 of Patents, &c., Act, 1883, May 3rd.) Dated December 3rd, 1900.

21,983. "Improvements in electric arc lamps." Crompton & Co., A. J. Hodgson and J. W. Ewart. Dated December 4th, 1900.

21,991. "Improvements in connections for electrical conductors." W. B. Cleveland. Dated December 4th, 1900.

22,006. "An improved oscillating thermo-motor applicable to various purposes." J. Hartig. Dated December 4th, 1900.

22,010. "An improved method of connecting electrical conductors." W. B. Cleveland. Dated December 4th, 1900.

22,019. "Improvements in storage batteries." A. Meygret. Dated December 4th, 1900.

22,021. "Improvements in arc lamps." J. Velle. Dated December 4th, 1900.

22,026. "Improvements in electric wave telegraphs." A. J. Boult. (American Wireless Telegraph Co., Wis., U.S.A.) Dated December 4th, 1900.

22,126. "Improvements in apparatus for wireless telegraphy." J. A. Fleming and Marconi's Wireless Telegraph Co. Dated December 5th, 1900.

22,142. "A new or improved telephone relay." E. S. Hagemann and V. Poulsen. Dated December 5th, 1900.

22,196. "Improvements in electric arc lamps." British Thomson-Houston Co. (Communicated.) Dated December 6th, 1900.

22,197. "Improvements in electric arc lamps." British Thomson-Houston Co. (Communicated.) Dated December 6th, 1900.

22,233. "Improvements in or relating to electric railways, tramways, and the like, on a sectional conductor system." C. Kando. Dated December 6th, 1900.

22,258. "Improvements in and relating to electric switches for use in controlling motors." E. T. Parker. Dated December 7th, 1900.

22,273. "Improvements relating to electrical plug resistance boxes, and like apparatus, and to switches therefor." C. T. Cambrell and T. E. Cambrell. Dated December 7th, 1900.

22,281. "Improvements in the means for suspending electroliers, electric lamps, and the like." E. Fletcher. Dated December 7th, 1900.

22,285. "Improvements in current collectors for electric vehicles." British Thomson-Houston Co. (Communicated.) Dated December 7th, 1900.

22,286. "Improvements in electric switches." British Thomson-Houston Co. (Communicated.) Dated December 7th, 1900.

22,287. "Improvements in synchronising apparatus for electric alternators." British Thomson-Houston Co. (Communicated.) Dated December 7th, 1900.

22,288. "Improvements in means for attaching pole-pieces to electric machines." British Thomson-Houston Co. (Communicated.) Dated December 7th, 1900.

22,316. "Improvements in or relating to electric cables or conductors." W. J. Glover. Dated December 7th, 1900.

22,330. "Improvements in alternate current measuring and indicating instruments." W. M. Mordey. Dated December 7th, 1900.

22,379. "Improvements in apparatus for the manufacture of electrical insulating materials." E. A. Claremont. Dated December 8th, 1900.

22,411. "Improvements in and relating to the electric return for electric tramways or street railways." W. B. Sayers. Dated December 8th, 1900.

22,503. "Electrical resistance switch." J. Cusworth. Dated December 11th, 1900.

22,515. "An automatic battery contact for electric bells." A. B. Mudie. Dated December, 11th, 1900.

22,521. "A method of marine or land night signalling." G. Cawley. Dated December 11th, 1900.

22,572. "Improvements in or relating to electrostatic machines." K. Schall. (Reiniger, Gebbert & Schall, Erlangen, Bavaria, Germany.) Dated December 11th, 1900.

22,584. "An electric furnace with two bedplates." A. C. Keller. Dated December 11th, 1900.

22,585. "Improvements in flexible supporting structures for electric lamps." W. F. Brewster. Dated December 11th, 1900.

22,599. "Improvements in the manufacture of incandescence bodies for electric glow lamps." A. Just and R. Falk. Dated December 11th, 1900.

22,605. "Improvements in and relating to plate holders for electric accumulators." T. Müller. Dated December 11th, 1900.

22,606. "A process for chemically consolidating the active material of electric accumulators." T. Müller. Dated December 11th, 1900.

22,662. "Process for the manufacture and repair of electrical glow lamps." F. Blau, A. Scharf, L. Loti, S. Loti and R. Latzko. Dated December 12th, 1900.

22,678. "Improved means for use in transmitting energy to electrically-propelled trains or tramcars." S. H. Short. Dated December 12th, 1900.

22,679. "Improved means applicable for use in operating and controlling electrically-propelled trains or tramcars." S. H. Short. Dated December 12th 1900.

22,698. "Process of extracting and reducing metals by electrolysis." F. H. A. Hamilton. Dated December 12th, 1900.

22,699. "Process of recovering and separating metals from their ores and concentrates thereof." F. H. A. Hamilton. Dated December 12th, 1900.

22,775. "An improved arrangement of cut-outs and apparatus for the better protection of electric cables and generators." Callender's Cable and Construction Co., and J. O. Callender. Dated December 13th, 1900.

22,779. "Improvements in mounting telephonic instruments and accessories, so as to admit of interchanging or renewal of the various parts." M. Byng and F. G. Bell. Dated December 13th, 1900.

22,788. "Improvements in joints for earthenware pipes or conduits, and in the means employed for producing the same." H. L. Doulton and C. E. Morris. Dated December 14th, 1900.

22,819. "Improvements in high-tension electric fuses." A. Eckstein and A. J. D. Krause. Dated December 14th, 1900.

22,848. "Improvements in arc lamps." J. D. F. Andrews. Dated December 14th, 1900.

22,902. "Improvements in electrolytic methods and apparatus." E. Edser and M. Wilderman. Dated December 14th, 1900.

22,910. "An improved means for tilting the shades and lamps of electric lighting pendants." J. B. Belcher. Dated December 15th, 1900.

23,014. "Improved high voltage quick-break single-pole, double-poles, or multi-poles switch." A. E. Short. Dated December 17th, 1900.

23,106. "Improvements in galvanic batteries." C. A. Allison. Dated December 18th, 1900.

23,107. "Improvements in galvanic batteries." C. A. Allison. Dated December 18th, 1900.

23,146. "Improvements in electricity meters." E. Schattner. Dated December 18th, 1900.

23,148. "Improvements in or relating to the connection of current conductors separated by dilatation gaps and apparatus therefor." K. Holzmann. Dated December 18th, 1900.

23,155. "Improvements in the arrangement and connection for single and multiplex wireless telegraphy." V. I. Feeny. Dated December 18th, 1900.

23,163. "Improvements in portable apparatus for wireless telegraphy for military and other purposes." J. A. Fleming and Marconi's Wireless Telegraph Co. Dated December 18th, 1900.

23,242. "A new or improved regulating device for electric current generators." M. de Hoor, F. Reinitz and L. Stark. Dated December 19th, 1900.

23,254. "Improvements in telephone systems." G. B. O. Sleebos. Dated December 19th, 1900.

23,310. "Improvements in electrical accumulators." British Power Traction and Lighting Co., and G. J. Gibbs. Dated December 20th, 1900.

23,328. "An improved controller and switch for electric lifts." J. Bush and M. T. Medway. Dated December 20th, 1900.

23,361. "Improvements in and relating to electrical fuse carriers for distribution boards and the like." G. Sperryn and W. H. Wood. Dated December 21st, 1900.

23,366. "Improvements in or connected with electric motors." W. Whitsley. Dated December 21st, 1900.